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SPRUE

AND ITS TREATMENT

BY

W. CARNEGIE BROWN, M.D., M.R.C.P.

NEW YORK

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PREFACE.

ALTHOUGH the actual cause of Sprue remains undiscovered, much important information as to the nature of the disease, and the most effective methods of dealing with it, has gradually accumulated. In recent years, opportunities for the study of the symptoms and epidemiology of Sprue have been greatly enlarged; the literature of the subject is considerable; new theories of pathology have been advanced; while the results obtained by different systems of treatment and by much careful clinical observation have become available, and are now fully established.

In view of these facts, of the recent great increase in the European population of the Eastern Tropics, and of the rapid extension of Sprue, a summary of the knowledge which has been acquired with regard to this remarkable affection may be found useful.

The study of an intestinal dyscrasia such as Sprue involves the investigation of many problems which lie beyond the usual field of a physician's duty. Accurate analyses of intestinal products, and intricate bacteriological research, are required for the elucidation of a host of doubtful points in the internal medicine of the Tropics; and, if the biochemistry and microbiology of Sprue are inadequately dealt with, it is not because their importance is insufficiently appreciated, but because it is so great that authoritative statements can be made only by experts in these sciences. Little

exact knowledge is as yet available, and investigation necessarily proceeds slowly. In the Tropics, clinical material is abundant, but adequate apparatus and competent workers are lacking; whilst in England, apart from the difficulty of obtaining suitable cases, the symptoms and essential nature of the disorder are so modified by change of climate and surroundings that results afford but an imperfect reflection of the true pathology.

The demography of Sprue is also unsatisfactory in that statistics of the prevalence and fatality of the disease are seldom available. Official returns of the percentage of officers and men in the various Naval and Military Services, and in Government employment, who are invalided for Sprue, are rarely obtainable; and our knowledge of the incidence of the disorder is almost wholly based on general statements. Still more unreliable and inexact is the statistical information as to the prevalence of Sprue in the Civil population, and the relative rates of mortality and frequency in different peoples. The predilection of Sprue for Europeans is prominent and obvious, but statements as to race preference and other notable characteristics of the disease can seldom be supported by trustworthy figures. Little beyond general impressions and experience can be adduced in support of facts which have long been fully recognized.

A special endeavour has been made to emphasize the necessity of early treatment, and to describe as fully as possible the various methods which are now employed. In dealing with the dietetic management of an affection which originates in the Tropics, it is not sufficient to enumerate the measures which are possible in Europe; the different conditions under which Sprue may be encountered must also be taken into account. In the Tropics, the question is not "What treatment is best?" but rather, "What treatment is available, and how far can the means at one's disposal be adapted to the case in hand?"

A narrative of the treatment of Sprue is necessarily a statement of possible dietetic measures, which should be comprehensible and readily applicable by those immediately concerned with the care of a patient, in the Tropics as well as at home. This must be an excuse for many redundancies and defects of description, and for a minuteness of detail that would otherwise be unnecessary, but which, it is believed, is essential to lucidity and practical utility.

The object of this contribution to the literature of Sprue will be more than attained if it renders even the smallest assistance in the treatment of the disease, and thus contributes in some measure to the relief of suffering in the large community of Europeans who are now resident in the Eastern Tropics.

32, *Harley Street, London, W.*,
July, 1908.

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CHAPTER I.

SHORT DESCRIPTION—NOMENCLATURE—PREVALENCE AND GEOGRAPHICAL DISTRIBUTION—CLIMATIC INFLUENCES—SEX, AGE, AND RACE PREFERENCE.

SHORT DESCRIPTION.—Sprue is a disease of tropical origin, which manifests itself by morbid changes of an inflammatory and degenerative type in the structures that are principally concerned in the functions of digestion and nutrition. It is characterized by definite lesions, which, generally in consecutive and descending order, affect the different portions of the alimentary tract; it is usually attended by two distinctive types of diarrhœa—an earlier and a later; by atrophic contraction of the liver; and, in the advanced stages, by a characteristic form of toxæmia. The nature of the disorder is essentially insidious and chronic, and its progress is marked by remissions and exacerbations, occurring at considerable intervals. Incidence is chiefly on Europeans of lengthened tropical residence.

NOMENCLATURE—Sprue has shared to the full a disadvantage that attaches to so-called "new" diseases in having had to submit to the imposition of a large number of different names. It has been variously described by different writers as

psilosis, tropical aphthæ, white chronic tropical diarrhœa, Ceylon sore mouth, scorbutic diarrhœa, endemic entero-colitis, chronic enteritis of Indo-China, endemic diarrhœa of warm countries, cachexia aphthosa, stomatitis intertropica, aphthæ orientales, and athrepsie coloniale atrophique. With more consistency, Dutch physicians have adhered to the local term current in Java—Indische Spruw—and this word, anglicised into Sprue, has gradually been adopted throughout the East to designate what is now a recognised and familiar disease. To add to the difficulties of nomenclature, Sprue has, not infrequently, been confused with other intestinal derangements, such as white flux, hill diarrhœa and famine enteritis—disorders which, though in many ways akin to Sprue, are now known to differ widely from it in the essential conditions of causation and pathology. The question as to what name is most suitable for the affection is, however, of little consequence. What is important is that the term by which the disease is ordinarily described should be generally accepted and readily recognised. In dealing with a disorder in which neglect of the symptoms is too frequently followed by a fatal result, a multiplication of names entails worse evils than confusion and inconvenience; and it is essential that, whatever word is employed, it should be clearly understood by the public as well as by the physician. To designate this condition, cumbersome medical terms are entirely inappropriate, and it is to be hoped that no more will be coined. The term Sprue, borrowed, as we have seen, from the Dutch, by which the disease was originally described when first differentiated as a separate morbid process, appears to fulfil the desiderata of nomenclature better than any of the others that have, so far, been suggested. It is definite and characteristic; it implies no rigid canons of pathology, or of geographical prevalence; and, what is perhaps the strongest

claim to general adoption, it has already received the sanction of wide acceptation.

PREVALENCE AND GEOGRAPHICAL DISTRIBUTION.—To residents in the East Indies, and especially to those Europeans who, in rapidly increasing numbers, are now hastening to colonise the Eastern Tropics, Sprue has of late assumed a position of very definite importance. The increase and extension of the disorder will scarcely be credited. Undescribed and unrecognised as a distinct disease fifty years ago, it is now so prevalent in some of the Settlements and seaports of our Eastern possessions that it has been computed that at least half of all the Europeans who have had fifteen years' residence are more or less seriously affected. And this exceptional incidence and liability to contract the disorder increase proportionately with the length of tropical service.

For many reasons, but especially from the circumstances that different views have prevailed as to the nature of the disease; that there are many variations in type; that in some Settlements it assumes a grave and fatal form, while in others, although more common, it is less malignant, Sprue has too often been imperfectly understood and recognised. It is, perhaps, not too much to say that, even now, most of the deaths which it occasions are ascribed to other causes. Estimates of prevalence and severity are, in consequence, of little value. Even when official records and statistics are available, they can scarcely be regarded as reliable. In the Straits Settlements, Federated Malay States, and Siam, where Sprue is undoubtedly one of the most common diseases, the disorder is by no means prominent in the mortality returns, but when it is borne in mind that the incidence is largely on Europeans, who, in point of numbers, form a comparatively insignificant portion of the population, and that many of them, when seriously ill, are sent home for

treatment, this apparent anomaly is to some extent explained. In the older French Settlements of the Farther East, Sprue is exceptionally prevalent. Ever since the original colonization of Cochin China in 1861-62, the severity of the disease has been such as to occasion great anxiety, and at times its virulence has given rise to apprehensions that it might ultimately be found necessary to abandon the Colonies. Known as endemic diarrhœa or entérocolite endémique, no other disorder has equalled it either in point of frequency or fatality. The troops which first occupied Saigon and Annam were decimated by Sprue, and though of recent years there has been much improvement in the sanitary condition of the colony, the civilian settlers and the naval and military forces still pay a heavy toll to the ravages of the malady. Recent figures are, unfortunately, not available, but the extent of the difficulties which were at first encountered may be estimated from statistics published during the first years of the military occupation.

During the year 1864, which was by no means one of exceptional insalubrity, out of a total strength of 9,223 French soldiers and sailors in Annam there were 3,501 cases of intestinal disease, 198 of them being fatal; 85 deaths were due to Asiatic cholera, and 113 to other disorders, and, in accordance with the ideas then prevalent, the great majority of the latter were ascribed to chronic dysentery. It is, however, noteworthy that no instances of liver abscess were reported, a circumstance which Dutroulau noted, and from which he drew the inference that the dysentery was of an exceptionally mild type. Subsequent experience showed, however, that practically the whole of these were cases of Sprue.

In the Dutch Indies, though the mortality has been somewhat less, Sprue is almost everywhere prevalent, and the European troops and civil populations in Java, Timor, Celebes and Macassar suffer severely. In the Dutch and English settlements in Borneo, in

Sarawak, and in the British territories of Labuan and North Borneo, the disease is of frequent occurrence, and in Ceylon, where it is popularly known as "Ceylon sore mouth," it is exceptionally prevalent. Strangely enough, it is less common in some of the intervening Settlements; it is, for instance, infrequent in Tonquin and Hong Kong, although a serious and often fatal form of the disorder is prevalent in the Treaty Ports of China, in the Philippines, and in Shanghai.

Sprue is, further, of peculiar interest in that it is a characteristic type of regional as opposed to climatic disease. That is to say, it is almost invariably seen in persons who have lived within a certain well-defined area; beyond the limits of that area it is practically unknown. Endemic and widely prevalent in the countries of its preference, in regions of similar latitude and atmospheric conditions it does not occur. Like yellow fever and certain other exotic diseases, it has its own *foyer*, but, unlike them, it has never spread in epidemic form. It has spread, and spread rapidly; but, essentially a tropical disease, it is peculiar in that its tendency has been to diffuse itself north and south, rather than along the equatorial parallels. In the Malay Peninsula, it is perhaps the most prevalent of all the many serious intestinal disorders to which Europeans are liable; yet in countries of like latitude and climate, as, for instance, the tropical States of America, it is seldom, if ever, seen. In North and South China, in Cochin China, in Java and the East Indian Islands, it is extremely prevalent, but it does not contribute to the mortality returns of Mexico, Florida, or the West Indies. It is also peculiar that, though a disease apparently identical with Sprue was described by HILLARY, of Barbados, 150 years ago, as being not uncommon there and in Jamaica, nothing now seems to be known of it in these islands. I am aware that cases have from time to time been reported from various places

in the Western Tropics, but it is questionable, in my opinion, whether genuine Sprue ever originates in any part of the world except the tropical and sub-tropical regions of Eastern Asia. The focus of the disease is to be found within a rough circle, which has Singapore for a centre, and which embraces the Malay Peninsula, Annam, Siam, Java and Sumatra. From this region it seems to have been conveyed by diffusion to other countries: westward and northward to Ceylon, India, and Burmah; eastward and northward to China; and eastward and southward to North Australia, New Caledonia, and the Fiji Islands. Sprue is further singular in that, although extension has thus taken place along the trade routes to the seaports, it has accurate racial and geographical limits. It does not, for instance, affect the native populations of the *Hinterlands*—so far as we know, it is co-terminous with European settlement—and though prevalent in Shanghai, Borneo, and the Philippines, it is very rare in Japan. Its distribution is, however, by no means uniform; in some places within this large area it appears never to have taken root. The comparative immunity of Tonquin and Hong Kong has already been noted; while in Deli (Sumatra), where there is a large population of European planters, and in Acheen, where there are many Dutch troops, it is of exceptional occurrence. Nor is it more uniform in type: in certain Settlements—generally, where the disorder has the greatest prevalence—it is essentially mild and chronic in nature. Many cases recover almost without treatment or special care, many more tend to become latent; and it is rare for the disorder to assume a progressive and malignant form. But in other localities where the disease is perhaps less general, the type is more severe and acute. In such places, of which Cochin China is an example, it is unusual for Sprue to become latent; more than half of all the cases are serious, and, without

careful treatment, tend to a fatal issue. In other Settlements, too —of which Shanghai may be instanced as an illustration—though the actual number of infections is, relatively, still smaller, the incidence of the disease appears to be greater in that the cases are well marked and the course is almost invariably pernicious and progressive. For these variations in prevalence and type no adequate explanation has been offered, and further statistics and more accurate observation are urgently demanded.

CLIMATIC INFLUENCES.—Within this wide area of distribution there are considerable variations in climate; so far as can be seen, Sprue is propagated with equal facility in all of them. It flourishes in the cool upland atmosphere of the hills and patnas of Java and Ceylon, in the perennial moist heat of the alluvial littoral in the Malay Peninsula, in the seasonal extreme temperatures of North China. But it is at least probable that great heat and moisture are essential factors in its causation, and that, though the disease not infrequently appears to originate in the hills, the actual infection of sprue has been conveyed in the plains. Be this as it may, it is certain that only those who have been exposed to very high temperatures acquire the disease; that its favourite habitats are subject to the heavy rains of alternating monsoons; and that clinical experience confirms the popular belief that, though in places with well-marked seasons it is less prevalent, the type is there more malignant.

SEX.—Sprue is common to both sexes. Females are affected equally with males. European ladies, who have been the subjects of anæmia or chlorosis, are, in middle life, particularly liable to the disorder.

AGE AND RACE PREFERENCE.—Sprue usually occurs as a disease of mature years. It is exceptional to see it in Europeans before the age of 35, and it seldom declares itself till

after 40. But this characteristic is obviously due to the circumstance that their tropical life does not as a rule commence before they are adults, and that only those of them who have had a considerable period of residence—fifteen to twenty years—are prone to attack. In young adolescents, born of white parents and reared in the Tropics—a class peculiarly subject to disorders of a degenerative tendency—Sprue is by no means uncommon. In the Malay Peninsula, Eurasians, a numerous and generally healthy community of mixed parentage, who are mostly of Portuguese descent, are frequently affected; and in them, too, it occurs at all periods of life after the age of puberty. Their long settlement as East Indian colonists might have been expected to render them to some extent refractory to climatic disease, but, as a matter of fact, they are extremely liable to malaria, and their susceptibility to sprue, though greater than that of the native races, is less than that of Europeans. It is, too, noteworthy that in the matter of liability to disease the Caucasian element of their parentage appears to predominate, and that their tendency is to acquire the maladies of the European rather than those of the Oriental. Sprue does not occur in infants or children, but in advanced age it is very common. Consequent, doubtless, on the combination of its own degenerative processes with the debasement of tissue incident to senility, sprue is then apt to assume a malignant type, and the progress of the disorder to be retrograde and rapid.

Proportionately to their numbers, Europeans suffer much more severely than other races. Natives are by no means exempt, but Sprue is, pre-eminently, a white man's disease. In the area which has been indicated as its original home, the population is largely alien. Extensive immigration has taken place both from East and West, and the incidence of sprue seems to be proportional to the capacity for acclimatization that is possessed by the various stocks.

In this respect, indeed, a clear line of distinction is drawn between sprue and the more acute intestinal affections, such as Asiatic cholera, acute enteritis and dysentery. These latter affect all races alike, and furnish a copious contribution to the total death-rate; sprue selects the European as the most favourable medium for development. The Malay, indigenous for some four hundred years, is little, if at all, affected by sprue. Chinese, who, during the last two centuries, have immigrated in enormous numbers to labour as miners and agriculturists in these productive lands, who have largely adopted the customs of the country, and of whom a large proportion are now to all intents natives, enjoy an almost equal degree of immunity. Arabs, Tamils, and other immigrants from India and Western Asia acquire the disorder somewhat more frequently, but it is one of the many peculiarities of sprue that the full strength of its infective force is seen only in Europeans. The explanation of this pronounced race predilection is by no means easy, although the fact is an established and prominent one. Probably no two affections afford a better illustration of the peculiarities of racial predisposition than Beri-beri and Sprue. Both distinctively diseases of the Eastern Tropics, both so prevalent in certain places as to be, for the people of their selection, almost incidents of residence, the difference in their preference for the Mongolian and the Caucasian is as marked as the divergence of their symptoms. In the open alluvial workings of a tin mine in the East Indies all the employés are exposed to the same atmospheric conditions, to the sun, to the rains, and to the close humid air of the jungle. The Chinese coolie is stricken with beri-beri, his European overseer with sprue. In no essential condition, even in that of diet, are the circumstances of their daily life materially different. Further, though in other places beri-beri frequently attacks Europeans—*e.g.*, in the Dutch army of occupation in

Acheen and on board ship—in the Malay Peninsula the overseer never gets beri-beri, the coolie never gets sprue. We have here, manifestly, presumptive evidence that capacity to acquire a particular local disease is inherent in a race, and that the European constitution is exceptionally favourable to the acquisition and development of Sprue.

CHAPTER II.

Historical Narrative and Literature of Sprue.

So long ago as 1766, Dr. Hillary of Barbadoes recorded[1] the prevalence in that island of a disease which, apparently, was no other than Sprue. His account of the general character and progress of the disorder is evidently drawn from careful observation, and is full of circumstantial detail; it might, indeed, be a description of Sprue exactly as we now know it. After accurately describing the dyspepsia and gastric acidity, which he distinguishes as the initial symptoms, Hillary says of the tongue: "Soon after this burning heat, small pustulæ or pimples filled with a clear acrid lymph no bigger than a pin's head begin to rise, generally first on the end and sides of the tongue, and sometimes on the palate and roof of the mouth and lips, and soon after, the thin skin which covers these pustulæ slips off and the tongue looks red and a little inflamed though not swelled, yet is almost raw like a piece of raw flesh, and is so tender and sore that the patient can eat no food but what is soft and smooth, nor drink anything that is vinous, spirituous, or the least pungent, without acute pain, so that some suffer much from the want of proper food." Further on, he says: "In this state they continue several days or weeks, and sometimes for months, sometimes a little better, then worse again, and after

[1] "Observations on the Changes of the Air and concomitant Epidemical Diseases in the Island of Barbadoes." William Hillary, M.D., London, 1766.

a considerable time the pustulæ will disappear and the mouth grow well without any medicines or applications or manifest cause, and continue so for several days or weeks. . . . . But when the humour falls upon the intestines, it produces a diarrhœa with a sense of heat, and sometimes a griping (though the last not often), so that most of the juices run off that way, which greatly wastes and sinks the patient. These circumstances continuing, and the disease frequently changing from place to place almost continually deprives the sick of their proper nourishment, whence a true atrophy is produced, which at the last either sinks the patient or brings on a marasmus, which soon ends in death." HILLARY was careful to differentiate this, which he described as a new disease, from diarrhœa alba, or white flux, an ailment which apparently was well known in the West Indies. Of the latter, he says: "During both this and the last month several persons had a diarrhœa alba or white flux, in which their stools were more white than usual in a jaundice, though no yellowness appeared in their skin or their eyes, neither had they any pain in the region of the liver or in the biliary ducts, nor any other icterical symptoms, neither had they any unusual acidity in their stomachs or bowels that I could observe, yet their stools were more white than if their diet had been only milk, bread and flour, and also in several adults whose diet was the reverse; neither were the stools chylous as in a lientery. But these were generally pretty soon relieved by a vomit or a few small doses of ipecacuanha and a little rhubarb, with an opiate."

It is impossible to read HILLARY'S observations without being convinced that he had fully recognised the distinction, now generally admitted, between two disorders, one, the somewhat trivial derangement, which, under various names, white flux, white diarrhœa, Gee's coeliac diarrhœa, pancreatic diarrhœa, &c., is of frequent occurrence both in tropical and temperate climates, and the other a disease indistinguishable from sprue.

There is no further record, after HILLARY'S time, of the continued prevalence of the latter complaint, nor, indeed, do we again hear either from the East or West Indies of any affection which can be identified with sprue for nearly a century. During that time, however, English pathologists in India and elsewhere left numerous careful records and reports of intestinal disease in the tropics, and in not a few of them, the descriptions of the morbid changes are very striking. One is, indeed, almost constrained to believe that, without having recognised it as a definite and distinct disease, these physicians had not infrequently seen genuine cases of sprue. Thus, from the time of PRINGLE, who, in 1772, published an account[2] of the diseases then prevalent in the Army, and who, describing a form of chronic white diarrhœa, said of it that, in many instances, the villous coat of the intestine was in parts eroded, and in parts infiltrated and thickened, until that of CUNNINGHAM, who investigated in 1877 the morbid anatomy of a fatal epidemic of enteritis, which appeared subsequently to the great Indian famine, there are many descriptions of atrophic and desquamative degenerations in the intestinal mucosa that, so far as *post-mortem* appearances go, may well have been sprue. It is unfortunate, however, that the clinical histories of most of these cases are incomplete, and altogether insufficient to establish their identity. Most of PRINGLE'S war service had been on the continent of Europe, and some, at least, of the instances of intestinal atrophy described by him were of non-tropical origin.

The descriptions left by Indian physicians are more precise and definite. Writing in 1829, of an affection which he described as the chronic diarrhœa of long residence, TWINING made[3] the

[2] Pringle, "Diseases of the Army," London, 1772.

[3] Twining, "Clinical Illustrations of Disease in Bengal," 1829: Second Edition, 1835.

following significant statements: "Europeans, who have been many years in Bengal are occasionally affected with a chronic purging, which comes on slowly without any previous or distinct acute stage. The evacuations are copious, quite watery, and of a yellow colour: varying in different individuals from a bright orange to a pale straw colour; the nearer it approaches to the latter shade, indicates the more intractable disease. . . . The patients who have been under my care have been persons in good circumstances, and in whom the disorder could not be ascribed to want of the ordinary comforts of life, or to carelessness. They were generally of light complexion, active habits, and sober. . . . The appetite was generally good. . . . The patients stated that they had been slowly reduced and exhausted. They do not often recover without change of climate; for the disease is connected with an impaired state of the constitution. . . . When I have made *post-mortem* examinations, the coats of both the small and large intestines have been found remarkably thin and transparent, and in some of the subjects there were a few small superficial ulcerations over a considerable extent of the mucous membrane of the lower portion of the ileum; and the same sort of slight ulcerous disease in the cæcum and at the sigmoid flexure. The omentum and mesentery were attenuated and devoid of fat, and their glands were enlarged. The liver was of a greyish colour; its size decreased; its structure soft and pliable, but tough. . . . In many cases we find neither disease of the liver nor of any part connected with that organ. . . ."

In his general statement TWINING says nothing of the condition of the mouth, but in the detailed description of a case his notes are as follows:—

"Isaac L., aged 34, formerly a stout man, now much reduced

by a purging of six months duration. The evacuations are copious, fluid, feculent, generally of a healthy colour, but occasionally of a frothy appearance. The tongue is nearly clean and remarkably smooth; the gums swollen and glossy; he is frequently troubled with flatuency and eructations. The ailment commenced when he was residing at Simla, and his debility is now gradually increasing."

This patient, TWINING says, recovered completely on a treatment of nitric acid and tinct. opii, and "a carefully regulated diet."

ANNESLEY, again, who had an extensive experience of tropical disease in the Madras Presidency, speaking of autopsies on Europeans who had had a long service in India, most of whom appear to have also suffered from hepatitis and diarrhœa, says[4] that in such cases "the parietes of the abdomen are particularly thin, the integuments on the one side and the peritoneum on the other being firmly and intimately attached to the abdominal muscles which are much wasted, little or no cellular substance seeming to intervene. The omentum presents a leucophlegmatic appearance, being diaphanous, and its cells loaded with a watery fluid. . . . The small intestines are of a pale colour, much contracted and lined with a copious exudation of a thick cream-coloured viscid matter, which frequently seems to fill their calibre, to glue their internal surface, and to obstruct their canal. The large intestines are distended with flatus, their coats nearly transparent and empty."

There is, however, in ANNESLEY'S work no definite description of a disorder presenting the general characteristics of sprue, nor is there any reference to Hill diarrhœa or other forms of white flux.

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[4] Annesley, "Researches into the Diseases of India." London, 1841.

In 1854 Surgeon ALEXANDER GRANT, of the Bengal Medical Service, published an account of an affection[5] which, from its prevalence in Simla and three adjacent hill stations, he named Hill diarrhœa or diarrhœa alba. He described the disorder as manifesting itself in two different forms: one in which we recognize a close resemblance to Sprue, and another in which the symptoms are those of gastro-intestinal catarrh. He said the disorder was confined to the places he specified, and was unknown at Mussoorie, Darjiling and other hill stations. It is impossible to read GRANT'S circumstantial narrative without being convinced that the cases which he described as exemplifying the first type were actually instances of Sprue. But it is further probable that, instead of having to deal with two types of one disease, he had seen two entirely different diseases, in one of which the infection had been conveyed in China, whence the troops had recently returned, and which no doubt was genuine Sprue, and that the others were cases of the ordinary catarrhal diarrhœa prevalent in all Indian hill stations. As GRANT'S paper attracted considerable attention, and his views were widely quoted and copied (often incorrectly) by subsequent writers on Indian medicine, this question appears to be one of some historical importance, and further reference will be made to it in the chapter on Hill diarrhœa.

Some two years later, MOREHEAD, Principal and Professor of Medicine at the Grant Medical College in Bombay, published[6] an extensive and complete account of the clinical aspects of disease in India, and of the views that were then current on

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[5] Grant, "On Hill Diarrhœa and Dysentery." *Indian Annals*, Part I., p. 324.

[6] Morehead, "Clinical Researches on Disease in India." London, 1856.

tropical medicine. Though aware of GRANT'S paper, MOREHEAD is careful to express no opinion on his statements, and he himself does not appear to have seen any cases of Hill diarrhœa; certainly he had no experience of an affection resembling Sprue. He says very little about chronic enteritis, and nothing as to a marasmic or toxæmic condition. In the long list of *post-mortem* records by which MOREHEAD illustrates his remarks on dysentery and other internal disorders, the absence of any mention of atrophic lesions of the intestines is indeed somewhat remarkable, and would seem to indicate that, in Bombay at least, cases of atrophic marasmus were then very rare.

During the Indian famine of 1877, by which in Bombay, Mysore, and Madras alone, over five millions of persons perished, it was found that a large part of the enormous mortality was due to a highly fatal form of atrophic diarrhœa, which appeared in the districts where starvation and want were most accentuated. This disorder seemed to have much in common with Hill diarrhœa, as well as with other vague and undifferentiated types of enteritis then prevalent elsewhere in India; and as it was essentially of an insidious and progressive character, and attended by intense marasmic toxæmia, it has been considered by many physicians to have been, not improbably, an aggravated form of sprue. The *post-mortem* appearances, as given by Dr. D. D. CUNNINGHAM,[7] the pathologist who was deputed by the Government of India to make a special report on the nature of the epidemic, were as follows:

"The mucous membrane of the stomach, jejunum, and ileum," he says, "is white, pulpy, soft and bloodless: some traces of congestion, marks of disintegration in jejunum; disappearance of

[7] Cunningham: *Fourteenth Annual Report of the Sanitary Commissioners with the Government of India*, 1877.

epithelial coat; pigmentation and atrophy of subepithelial areolar tissue. Mucous membrane of ileum presents more obvious signs of change; bloodless generally, but, here and there, patches of congestion; epithelial coat disorganized or absent, and sub-epithelial tissues affected. Solitary glands either very few or almost entirely absent. Peyer's patches an empty network surrounded by slightly elevated ridges; adenoid tissue virtually absent, surface smooth, villi almost unrecognizable. Muscular coat covered only by a thin membranous investment, and seemed to form the inner lining of the tube. . . . Microscopical examination showed that the epithelium, where present, contained much fat, the cells including large quantities of oil granules. In the vicinity of denuded areas, vestiges of cells and free granular matter present. The sub-epithelial tissue showed evidence of similar changes; the nuclei granular and oily. This may to some extent have caused the appearance of pigmentation that was observed, but there was a certain proportion of pigment granules. . . . In the more advanced stages of atrophy, the nuclear elements in the villi appeared to be almost entirely absent, and the villi were represented by abortive processes containing granular matter. The mucous membrane of the large intestine was also generally anæmic, white, but mottled pink here and there, and its texture very soft. In some places there was thickening. Besides the general softening, there was evidence of loss of substance in some places. These patches in some instances might be called ulcers; in others they seemed to be merely the result of disintegration and atrophy. . . . The liver was small, pale, yellowish, fatty looking; in some cases the cells were healthy-looking; in others full of fat granules. . . . Pancreas, normal in some; in others, substance seemed as though it were opened out, the lobules widely separated."

This description is certainly suggestive of Sprue, but in view of the racial preference, of the absence of definite mouth lesions, and of other essential clinical characters, it is difficult to believe that the epidemic had any affinity to that disorder. Indeed, until we come to FAYRER'S work, no author mentions mouth lesions as being symptomatic or peculiar to an intestinal disorder, or as having attracted attention in any of the intestinal affections of India. If observed at all they seem to have been considered accidental accompaniments of various forms of enteritis, rather than pathognomonic signs of a distinct disease.

On the whole it must be confessed that a review of Indian medical literature of the first three-quarters of last century favours the view that if the physicians of that time saw any genuine cases of Sprue they were of very unusual occurrence. Whether, if the disorder had already secured recognition as a distinct morbid process, more instances would have been reported, it is difficult to say; but it is impossible to believe that had it been prevalent, a disease of such marked characteristics would have escaped the attention of these acute observers, and it would rather seem to have been the case that sprue, if it occurred at all, was very uncommon in India. It is obvious that most of the authors were familiar with the morbid changes which are to be seen in atrophic forms of diarrhœa; and the general results of their work, and of Cunningham's careful research, suggest that in all cases of chronic diarrhœa or dysentery, including sprue, when lack of nutrition and toxæmia have been marked features, a uniform type of pathological change supervenes, but that for purposes of diagnosis or differentiation, it is, in itself, and as compared with the clinical symptoms, of little value. Disorders, variously described as famine enteritis, famine diarrhœa, morbus bengalensis, &c., in which similar anatomical lesions were recorded, are certainly not variation forms

of sprue, and cannot be accepted as having any definite relation to it.

The next advances in the elucidation of the nature of sprue were made in the Farther East. Soon after the occupation of Annam and Cambodia by the French, it was observed that an unfamiliar type of diarrhœa was the cause of a high rate of mortality among the European troops; and close attention was directed to the study of its ætiology and pathology. The work done by the French naval and military surgeons was, as might have been anticipated, of a high order, and some of the published records of their researches are models of lucidity and completeness; but, unfortunately for the solution of the questions at issue, two different views as to the nature of the epidemic were almost at once propounded and advocated with so much vigour by their respective adherents that it is impossible to avoid the suspicion that many of the conclusions were based on preconceived theories rather than on actual observation. One school, which included several very able investigators, maintained that the disorder was only a modified form of dysentery, and that there was nothing to warrant its differentiation from that disease; the other, that it was an entirely distinct pathogenic process, widely separated not only from dysentery but from all other morbid conditions of the intestines.

One of the first writers on the subject was JULLIEN, who, in 1864,[8] examined, *post mortem*, 108 cases, and published a careful and accurate account of the morbid anatomy of the disorder. He enunciated the view that Cochin China dysentery, as it was then called, was a specific affection, and claimed that it might justifiably be classed as a new disease; but DUTROULAU, writing in 1868,[9]

[8] Jullien, "Lésions de la Dysenterie de Cochin Chine." Montpellier, 1864.
[9] Dutroulau, "Traité de la Dysenterie," Paris, 1868, p. 252; and Dutroulau, "Maladies des Européens dans les Pays chauds." Paris, 1868. Baillière.

gave it as his opinion, though he himself does not seem to have served in Cochin China, or to have had any personal experience of the disorder, that it was merely a variation form of chronic dysentery. He believed that dysentery, once established, might run its ordinary course with necrosis, ulceration of the colon, and the usual dysenteric symptoms; or that it might abort, and end in superficial ulceration with epithelial desquamation, and that the dejecta would then be colourless, pasty, and fermenting. Apparently, however, he did not arrive at this conclusion without some hesitation. The remarkable immunity to abscess of the liver in endemic diarrhœa of Cochin China had not escaped his notice, but he thought this peculiarity was to be explained by the fact—an erroneous assumption—that the dysentery was of a mild type. "La dysenterie," says DUTROULAU, "ne paraît pas avoir en Cochin Chine un caractère de gravité et de léthalité qui doive la faire considérer comme cause principale de l'insalubrité du climat . . . Ce qui motive surtout ce jugement, c'est la rareté relative de l'hépatite purulente." DUTROULAU'S view of the pathology continued to be the subject of much controversy, but supported, as it already was, by DÉLIOUX DE SAVIGNAC,[10] and later by the great authority of CHARCOT, it was generally accepted and may be said to have held the field until 1872.

In that year, M. LAYET published a thesis[11] in which he again asserted that the affection was peculiar to the Eastern tropics, and that in symptoms and geographical distribution it was distinct from chronic dysentery and chronic enteritis, which were common all over the world. In conjunction with LE ROY DE MÉRICOURT[12] he

[10] Délioux de Savignac, "Traité de la Dysenterie." Paris, 1865.
[11] Layet, "Thèse de Montpellier." Paris, 1872.
[12] Article "Cochin Chine." Encyclopédie des Sciences navales. Paris, 1874.

further elaborated, in an article in the "Encyclopædia of Naval Sciences," this theory of duality, and explained, by a carefully reasoned differential diagnosis, the distinction between dysentery and the endemic diarrhœa of Cochin China, as it had now come to be called. His views, in turn, prevailed and soon found many supporters. Among others, LAVERAN[13] expressed the belief that there could be no doubt about the protopathic character of the disorder; and in his interesting "Leçons Cliniques," published the same year in the "Archives of Naval Medicine," BARRALLIER clearly defined the position of current opinion. He said, "Je considère la Diarrhée de Cochin Chine comme une maladie distincte non seulement de la Dysenterie, mais encore des toutes les autres diarrhées qu'on peut rencontrer sous les tropiques."

Later, and it must be added, more complete researches were, however, by no means so unanimous. Until this time little, if any, microscopical work had been done, but an extended series of investigations into the histology of the intestinal lesions was now undertaken by M. KELSCH,[14] and later by M. BONNET,[15] professor at the Naval Medical School at Toulon. The results of their work were, on the whole, in favour of the identity of dysentery with endemic diarrhœa, and though their verdict seems to have been arrived at only after considerable doubt, they agreed to regard the difference as one of degree only, and ultimately gave a somewhat undecided adhesion to the doctrine of unity. After the publication of these researches, French physicians and pathologists appear to have once more adopted the view that the two diseases could not be differentiated, and it was again generally held that the endemic

[13] Laveran, "Société médicale des Hôpitaux," 1877.

[14] Kelsch, "Archives de Physiologie, 1875.

[15] Bonnet, "Note sur l'Anatomie pathologique de la Diarrhée de Cochin Chine," *Arch. Méd. Navales*, 1878.

diarrhœa of Cochin China was but a modified form of dysentery. Writing in 1880, M. MAHE, then Professor of pathology at the Naval Medical School at Brest, said that the efforts of pathologists to find points on which to draw a line of differentiation had been futile, and summed up the case as follows :—[16] "Il est, en effet, extrêmement vraisemblable que les mêmes altérations anatomo-pathologiques constituent le fond de ces maladies, qui ne diffèrent sous ce rapport entre elles que par des dégrés, de formes, et des nuances." This view was endorsed by BERENGER-FERAUD [17] in his Treatise on Dysentery published soon after, and received general acceptation, apparently, without further question. It is doubtful, however, if MM. KELSCH and BONNET meant to go so far: their articles, if carefully read, do not warrant the assumption, which appears to have been somewhat hastily adopted, that they had insisted on the unity of the two diseases. As the change of opinion was based on their researches, it is unfortunate that there should have been any ambiguity about their expressions, but it would indeed seem to have been the case that they were uncertain of their own conclusions; for KELSCH is nowhere positive, and invariably writes of epidemic diarrhœa as a separate disease, while BONNET actually named it "diarrhée dysentérique," as he says, only to indicate its connection.

This somewhat futile argument was continued, with varying fortunes, for several years; so far, indeed, as French opinion is concerned, the question can scarcely be regarded as settled to the present day, but it is difficult to see why all the confusion should have arisen. The description of the clinical manifestations

[16] Mahe: Article "Diarrhée endémique," "Dictionnaire encyclop. des Sciences médicales."

[17] Berenger-Feraud, "Traité théorique et clinique sur la Dysenterie." Paris, 1883.

of the endemic diarrhœa of Cochin China leaves no room for reasonable doubt that the disease, though aggravated during active service by unsuitable food, exposure, and excess, is identical with sprue; and it is, further, impossible to avoid the conclusion that, if more weight had been attached to symptoms and characteristic features, and less time spent in the endeavour to prove or disprove the identity of a disorder by the exact analysis of pathological lesions—themselves the expression, not of a particular morbid process, but of changes that invariably attend prolonged enteritis with failure of nutrition—the true nature of the disease would have been recognised. At the same time, one must not dismiss too hastily the doubts and the difficulties of the French writers. In Cochin China there are opportunities for pathological research that have not been, and probably cannot be, equalled elsewhere, and very great weight must continue to attach to the results of actual observations made there, and to the conclusions which have been deduced from them.

In the meantime, and, apparently, independently of the French physicians, and of each other, VAN DER BURG, in Java, and MANSON, in Amoy, had observed the prominent features of Sprue, and for the first time differentiated and described the disease by that name. In a paper published in the Medical Reports of the Chinese Customs Service, in 1880,[18] Sir PATRICK MANSON recorded the prevalence of a form of diarrhœa which principally affected Europeans who had a prolonged residence in China. He gave a detailed account of the disorder, pointed out the importance of the mouth symptoms as an essential sign of invasion, and described the insidious onset, the slow progress, and the tendency

[18] Manson: "Notes on Sprue"; nineteenth issue, Medical Reports of the Chinese Imperial Maritime Customs. Shanghai, 1879-80.

to relapse. He emphasised the serious and often fatal nature of the affection, and in view of readily impressing its dangers on the public, urged the necessity of adopting a distinctive name for a disease that had so many distinctive features. As a satisfactory designation, he suggested "Sprue," the term by which (as ROWELL of Singapore, who had also observed the disease, and with whom he had been in correspondence on the subject, informed him) it was popularly known in Java. MANSON insisted that the affection was a disease *sui generis*, entirely apart and distinct from all other intestinal affections.

In the same year (1880) VAN DER BURG, of Batavia, who had an extensive experience of Sprue in Java, published[19] an excellent clinical account of the disorder. He also adopted the term "Spruw," the usual colloquial name for the affection in the Netherlands Indies, saying that it was a distinct morbid process, clearly to be distinguished from gastro-intestinal catarrh on the one hand and follicular dysentery on the other. "The key to its diagnosis," he says, concisely and accurately, "is in the combination of symptoms furnished by the condition of the mouth, the intestinal tract, and the liver." He described, with much detail of clinical illustration, the preliminary bilious flux, the subsequent alteration in the dejecta, the contraction of the liver. In every important particular, his account of the disease, as it occurred in Java, tallied with that of MANSON in China. Reading the papers together, and comparing them with the descriptions of the French physicians in Cochin China, there can be no doubt but that all these reports referred to the same disorder. VAN DER BURG'S Essay, which was awarded a prize by the Society for the Advancement of Medical Science in Netherlands India, amplified and confirmed MANSON'S

[19] Van der Burg, "Indische Spruw, Aphthæ Tropicæ." Batavia, Ernst, 1880.

description of the disease; more particularly it endorsed his contention that Sprue was a protopathic affection, distinct and separate from other intestinal disorders; and in this, as it happened, it coincided with the theory which, at the moment, dominated the French schools.

From this time Sprue took a definite place in the category of diseases incidental to European life in the Eastern Tropics; and abundant corroboration of MANSON'S and VAN DER BURG'S descriptions was quickly forthcoming. That this affection was identical with the endemic diarrhœa of Cochin China was now admitted by the French physicians. "La question des exacerbations et rémissions périodiques," say MM. BERTRAND and FONTAN writing of that disorder, "admises par le Dr. P. Manson reservée, chacune de ces descriptions, on le voit, ressemble étroitement, au moins dans ses traits essentiels, à celle que nous avons donnée plus haut, d'après ce que nous avons observé nous-mêmes, et ce qu'ont rapporté nos camarades de la marine." [20]

In the Lettsomian Lectures delivered in 1881, which, though they contain a reference to Manson's work, appear to have been written before his paper reached England, Sir JOSEPH FAYRER described,[21] under the name of "Chronic white Tropical diarrhœa," a form of disorder which, he said, was one of the most tedious and intractable affections to which Europeans in India were liable. He differentiated it from Hill diarrhœa; and from all other gastro-intestinal disturbances characterised by colourless dejecta; and his account of the disease is remarkable, no less for the importance attached to the condition of the tongue and mouth as

[20] Bertrand and Fontan, "De l'Entero-Colite endemique." Paris, Octave Doin, 1887.

[21] Sir Joseph Fayrer, "Tropical Dysentery and Chronic Diarrhœa." London, Churchill, 1881. Pages 135 *et seq*.

symptoms of an Indian disorder, than for the graphic manner in which intestinal toxæmia is depicted as one of the essential features.

"The tongue," says Sir JOSEPH, "is red, dry and smooth, and, in advanced stages, it appears contracted and shrunk, its papillæ are obliterated, the surface is red, glazed and dry; at times its edges are excoriated, and the buccal mucous membrane is the seat of aphthous spots or epithelial proliferation, and so tender and sensitive as to be intolerant of wine or any substance or fluid in the least pungent or stimulating. . . . The appearance of persons suffering from this disorder is characteristic. They are pale and emaciated, with loose, dry, flaccid, flabby skin, which in later stages becomes discoloured as by chloasma or Addison's disease; the fat disappears . . . general languor and debility, mental and physical, increase, until all exertion is difficult and distasteful. As the diarrhœa gradually increases, these symptoms may, to a certain extent, be mitigated, and the patient think himself better, but, as it progresses, he sooner or later finds himself compelled to give up work, and seek recovery in change of climate. There is at last extreme anæmia, and dropsical effusions take place into the areolar tissue of the lower extremities."

Undoubtedly, this was Sprue, but the inference drawn by Sir JOSEPH—that mouth symptoms are of frequent occurrence in India—is unjustifiable. His description of the disease is based on cases seen in consultation practice in England, and not on the results of his experience in India, and he appears to have overlooked the fact that his patients, in almost every instance, had come from the Farther East, and not from India. Of the thirteen cases of which details are given, twelve were seen by Sir JOSEPH FAYRER in London; and it is, at least, a remarkable coincidence that of the

three in which ulceration and aphthæ are mentioned as being conspicuous, one came from Burmah, one had lived in Singapore, China and Batavia, and one only was from India.

After the true nature of Sprue had been disencumbered of the doubt and uncertainty by which it had so long been surrounded, the morbid appearances were investigated with renewed care and attention by French pathologists in Cochin China. M. KELSCH, now in collaboration with M. KIENER, again made a careful examination of the intestinal lesions, and in 1884 these authors published[22] a further account of their researches into the histology of the disease. They claimed that there is, in all cases, an initial lesion in the form of a deep localised necrosis somewhere in the intestine, and that the subsequent inflammation and ulceration are due to secondary re-infection from this primary sore. DUTROULAU, long before, had affirmed that a scar, marking the place of a previous important loss of tissue, was invariably to be found on the intestinal mucosa, in all cases of dysentery and on this ground had partly based his contention that the diarrhœa of Cochin China was essentially dysenteric in nature. The assertion as to the existence of such a lesion, though supported by some later French writers, was, however, not confirmed by English pathologists; they denied that it was invariably, or even usually, present, and regarded it as a rare and accidental complication rather than as an essential process of disease. Personally, I have never seen such a scar; and though a solitary cicatrix with marked fibrotic change is undoubtedly to be found in a certain proportion of cases, it can scarcely be believed to have any causal or pathological significance.

Two years after the publication of KELSCH and KIENER'S research, MACLEAN, Professor of Medicine in the Army Medical

[22] Kelsh et Kiener, *Archives de Physiologie.* Fevrier, 1884.

School at Netley, issued[23] his "Lectures on the Diseases of Tropical Climates." Not having seen MANSON'S or VAN DER BURG'S papers, he did not refer to their work, but he described, under the name of scorbutic diarrhœa, a disorder which he said was prevalent in India. He distinguished it from Hill diarrhœa, and from other forms of white flux, and there can indeed be no doubt that the affection was identical with sprue. It is unfortunate, however, that Maclean's description, like that of Sir Joseph Fayrer, appears to be based on experience of the disease as he had seen it in consulting practice at home, rather than on accurate recollection of the results of his long service in Madras; and it is, therefore, of little value as an index of the prevalence of the disorder in that Presidency. In the case which he cites as a typical instance—the only one which is described in detail—the disorder had been acquired in Ceylon, and was, obviously, "Ceylon sore mouth," or genuine sprue; but MacLean's general statement shows that he was well acquainted with the peculiar mouth lesions of sprue. He thought them peculiarly symptomatic of the affection, and enunciated the view—a theory which GRANT had previously propounded—that the stomatitis and aphthæ are of scorbutic origin, and that, to effect a cure of the disease, anti-scorbutic remedies are required. Had he been writing at the present day, he would, no doubt, have instanced the fact of the accepted treatment for sprue being anti-scorbutic as corroborating his doctrine; but, in view of the circumstances that sprue is not attended by other symptoms of scurvy, and that it chiefly affects a community who regularly consume considerable quantities of fruit and vegetables, this theory of origin may at once be dismissed as untenable. As an apposite and quite independent observation of the disorder, MACLEAN'S contribution to the literature of the subject is, however, of very great interest.

[23] MacLean, "Lectures on the Diseases of Tropical Climates. London, 1886.

"White flux," he says, "is not confined to the hill stations of India; a very obstinate form of diarrhœa, in which, after a time, the stools present the pale drab or whitish colour described above, is seen on the malarial plains, and, when neglected and allowed to become chronic, it is a tedious and dangerous affection, reducing the sufferers to an emaciated and anæmic condition, under which they ultimately succumb. The disease begins in an insidious way, at first exciting little attention and no alarm. The motions may not exceed two or three in twenty-four hours; are not in the first instance either pale coloured or fluid, only assuming their characteristic appearance at a later stage. If not checked by appropriate treatment, symptoms of grave constitutional derangement appear; the patient becomes dyspeptic, suffers from flatulent colic, the tongue becomes red, smooth and glazed; the mouth is covered with aphthous sores, which extend to the edges of the tongue; the appetite fails, nutrition becomes daily more imperfect, and the stools having now assumed their characteristic appearance become more frequent and copious, and are voided with violence—an invariable symptom of a scorbutic condition, which is now fully established. This white flux should, in my opinion, be designated "Scorbutic Diarrhœa."

CHEVERS' well-known "Commentary on the Diseases of India," published in the same year,[24] contains a somewhat extended reference to chronic tropical diarrhœa as he had seen it in Bengal. He distinguishes it from the endemic enteritis of India, the origin of which is attributed to permanent insufficiency of food, and to which, he says, the greater part of the enormous mortality among the lower classes of natives is due. But the description does not appear to be based on personal observation, and is altogether

[24] Chevers: "A Commentary on the Diseases of India." London, Churchill, 1886.

indefinite and inconclusive. The disorder described by MANSON is confused with Hill diarrhœa, and the account of his own experience gives the impression that CHEVERS had, himself, seen in India no cases that can be identified with sprue. He fully recognized, however, the importance of a careful distinction being drawn between the various forms of intestinal flux endemic in the Tropics, and he urged on the Government of India the necessity of further exact research into the relations of "morbus Bengalensis" (the designation he proposed for starvation enteritis) to chronic tropical diarrhœa and dysentery. His recommendation could not, unfortunately, be accepted, but he was careful to record his own opinion, which strongly confirms the general experience that there has seldom been any difficulty about the differentiation and identification of dysentery in countries where sprue is not endemic. Referring to the opinion of ROUX, and of the French physicians in Cochin China, CHEVERS, whose experience of dysentery in India was probably unequalled, made the following emphatic statement: "If this chronic white flux be an outcome of dysentery, it is singular that it never followed that disease in any of the many hundred cases which came under my care in Bengal. To say that these patients have suffered from dysentery is merely to say what may be said of nearly everyone who has resided in India."[25]

In 1887 an important work on the disease was published by MM. BERTRAND and FONTAN,[26] respectively Professors of Hygiene and of Anatomy at the Naval School of Medicine at Toulon, in which they described, under the name of chronic endemic entero-colitis of warm countries, the disorder which had committed such ravages

[25] Chevers: "A Commentary on the Diseases of India." London, Churchill, 1886.

[26] Bertrand et Fontan: "De l'Entéro-Colite chronique endémique des Pays chauds." Paris, Octave Doin, 1887.

among the naval and military forces in the French tropical colonies. They were cognizant of MANSON'S and VAN DER BURG'S work, and, as we have seen, they fully admitted that the disease was identical with the sprue which these authorities had described, and with the white chronic tropical diarrhœa of FAYRER. Their elaborate monograph, based on extended clinical and pathological investigation, is the most complete record of the various aspects of the disorder that has yet been published and still remains the standard work on the subject. MM. BERTRAND and FONTAN did not, however, agree in every particular with the accepted description of sprue; they were unable, as we have seen, to confirm—so far as regarded the Cochin China disorder at all events—the statements that had been made as to the undulating and relapsing nature of the symptoms, and they could not resist the temptation—a fascination against which French writers, almost without exception, seem to have been powerless—of again raising the question of the identity of sprue and chronic dysentery. In this they appear to have been largely influenced by the recently published work of KELSCH and KIENER, and especially by the assertion as to an initial lesion, and, after a lengthy and detailed recapitulation of the discussion, they declare themselves unicists. "Nous sommes unicistes," they say, "notre conviction étant que la dysenterie et la diarrhée chronique endémique ne sont pas deux maladies différentes. . . . En fait, la maladie est un quant au fond." But it is difficult to reconcile this conclusion with the clinical and pathological facts which they have so carefully marshalled, or, indeed, with their general argument. The whole tenor of their work is to emphasise the individuality and pathognomonic character of the disease which they describe, and in many ways their book can only be regarded as a conclusive argument for dualism. In other respects, however, it is a model of accurate research and lucid description.

That the views of MM. BERTRAND and FONTAN on this point did not represent general French opinion is evident from the fact that ROUX—a naval surgeon of much experience—in his work on tropical diseases, published in the following year (1888)[37] was careful to differentiate sprue from dysentery. He stated that these disorders had been confounded because many of the cases examined were instances of simple chronic dysentery, a disease which, he said, as in other parts of the Tropics, was common enough in Cochin China, which existed there alongside and independently of the more prevalent sprue, and which was the cause of toxæmic symptoms so similar as to be almost indistinguishable. He, however, regarded the mouth symptoms, the white diarrhœa, and the dyscrasia, combined, as being pathognomonic. Dr. ROUX'S views are of much interest, in that he arrived at the same conclusions as MANSON and VAN DER BURG, though apparently he was unacquainted with their work, and in that he had a lengthened experience of service not only in Cochin China, but also in Bengal, where, he says, he never saw a case. He considered sprue to be peculiar to the farther East, and thought that the British troops in India derived their immunity from the superiority of their rations, and better conditions of life.

During the next decade, two editions of a work[38] on sprue were issued by Dr. GEORGE THIN, who had exceptional experience of the disorder, both in Shanghai and in London. In the hope that one common name might be adopted for a disorder which continued to be differently designated in different countries, and,

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[37] Roux: "Traité pratique des Maladies des Pays chauds." Paris: Stienheil 1888.

[38] "Psilosis or Sprue," by George Thin, M.D. Second Edition, London: Churchill, 1897.

believing that general approval might be secured by a term of, apparently, more scientific origin, Dr. THIN suggested the title Psilosis, as expressing to some extent the nature of the morbid change. But the suggestion can scarcely be regarded as an exception to the rule that nomenclature based on pathological conditions is unsatisfactory.

It was true that the word Sprue had not secured universal recognition; it had not been adopted by the French, but it was in general use among English, Dutch, and American physicians, and it was becoming well understood by laymen in the East. The introduction of an entirely new term seems therefore to have been somewhat unfortunate, although, in other respects, Dr. THIN'S work is a notable contribution to the literature of the subject, and a lucid exposition of the views which he held as to the nature and proper treatment of the disorder. On some important points, however, he found himself at variance with accepted opinion. He did not, for instance, consider that the endemic chronic diarrhœa of Cochin China was identical with the Sprue of China and Malaya; he thought, in fact, that it was a distinct disease. In this contention it can scarcely be that Dr. THIN was right. His views stand in direct opposition to those of Sir JOSEPH FAYRER, of M. ROUX, of MM. BERTRAND and FONTAN, and, indeed, to those of all other authorities who have personal knowledge of the two disorders. It is, besides, somewhat difficult to see on what grounds he arrived at his belief; for he had, himself, no experience of the Indo-China endemic, and he appears to have based his opinion on cases described by BERTRAND and FONTAN, from which they themselves deduced an entirely opposite conclusion. With reference to the important question as to the occurrence of sprue in India, Dr. THIN does not seem to have read GRANT'S paper on Hill diarrhœa, and the passage which he cites from CHEVERS as

expressing GRANT'S views inaccurately represents GRANT'S meaning. THIN, however, differentiated sprue from Hill diarrhœa and the white chronic diarrhœa of India, and identified it (again, I think, correctly) with "Ceylon sore mouth." He gave a complete and accurate description of the mouth lesions (to which, as an essential feature of the disease, he attached much importance), the characteristic facies, the shrunk and emaciated frame, the mental irritability, the anæmia, the disordered digestion, and the failure of nutrition. His chapter on Ætiology contains many original ideas as to the nature of Sprue, and his directions for the treatment of the disease as it is seen in England are full and explicit.

Recent contributions to the literature of the subject have been of minor importance, but the following may be mentioned as being worthy of note :—

An article on Sprue in Manila, MUSGRAVE, *American Journal of Medical Science*, March 25, 1902; a discussion on Sprue at the meeting of the British Medical Association, 1903; a paper by H. RICHARTZ, "Ueber Aphthæ Tropicae oder Indische Spruw" (*München. Med. Wochenschrift*, 1905, p. 640); a careful description of the disease by VAN DER SCHEER in "Mense's Handbuch der Tropen-Krankheiten"; and two further papers by VAN DER SCHEER and G. T. WALTER in the "Nederlands Tijdschrift van Geneeskunde" in which these authors advance the theory that Sprue is a larval form of appendicitis.

The most adequate and complete text-book articles on Sprue are those by Sir PATRICK MANSON in his well-known "Manual on Tropical Diseases" (1903) and in Allbutt and Rolleston's "System of Medicine" (1907).

CHAPTER III.

THE SYMPTOMS AND SIGNS OF SPRUE.

LIKE most of the other manifestations of sprue, the commencement of the disorder is insidious and uncertain. In no affection of the alimentary system is the seat of the first disturbance of function, the position of the initial lesion, or the actual date of its appearance so difficult to determine. In the great majority of instances so slight and evanescent are the primary symptoms, that it is the exception for a patient to know whether gastric inefficiency preceded soreness of the mouth, or tendency to diarrhœa was not apparent before either. It is, indeed, rare for the physician to be able to lay his finger on some particular spot, and to say with assurance, " Here, and at such a time, occurred the first indication of disease." Yet, in Sprue, early intimation of something being wrong is seldom absent. A peculiar and characteristic feeling of lassitude and malaise, a sense of failing strength and undefined illness is, almost invariably, a preliminary to actual attack.

After some weeks or months, during which the languor and uneasiness persist intermittently and with greater or less intensity, tangible evidence of the nature of the disorder is generally furnished by the condition of the mouth. As a rule, the lesion is at first trivial and almost unnoticeable, but careful examination may reveal one or two congested spots or small vesicles on the edge of the tongue. On being questioned as to their

—	PROGRESSIVE PERNICIOUS ANÆMIA	
Skin	Lemon yellow; pallor; sometimes pigmentation	Dull; sallow; lates legs, eczemas of t
Temperature... ...	Interrupted fever usual; increase of symptoms during fever; at other times temperature generally subnormal.	Interrupted fever ge vals temperature s
Mouth	Stomatitis common, tongue pale and small; often sores and aphthæ.	No stomatitis ...
Stomach and intestines	Generally dyspepsia; pain not usual; gastritis and enteritis, followed by atrophy. "Anadenia" (Ewald). These are not specific lesions; they are secondary to anæmia. Various intestinal parasites, *e.g.*, oxyuris often seen, but these often not specific. Diarrhœa not infrequent, constipation more usual; dejecta scanty.	Stomach not affecte duodenale present very frequently oc ling of mesenteric rhœa, sometimes d found; cholesteri
Circulation	Palpitation, breathlessness and cardiovascular symptoms invariable; hæmic murmurs and hæmorrhages common and of marked intensity. Blood reduced in quantity, in sp. gr., in albumins and in Hb. Coagulation feeble, colour pale to normal. R.B.Cs. profoundly altered and reduced to 1,000,000 c.mm., or less, with changes in form, size, and staining reactions. Leucocytes reduced in number; lymphocytosis common; no eosinophilia.	Palpitations, breath (3,500,000 to 2,00 megaloblasts freq increased; great i nuclears, and decr
Respiration	Not directly affected	Chronic bronchitis o
General	Always lassitude, and feeling of illness. No wasting; subcutaneous fat usually increased. In females menstruation generally diminished or arrested, rarely excessive; tendency to abortion.	Lassitude and disin No loss of weight increased. In fe diminished or arre
Nervous System ...	Degeneration of posterior columns usual, often with tabetic symptoms, or spastic paralysis. Occasionally combined sclerosis, with complete paralysis.	No organic lesions. quent; analgesia, vertigo, frontal he
Sense Organs ...	Pupils dilated; optic neuritis and hæmorrhages frequent	Pupils dilated; scle
Muscular System ...	Muscles pale; occasionally intense red; petechiæ common; fatty degeneration of myocardium very frequent. Force and electric excitability reduced.	Muscles pale, not s excitability much
Liver	Enlarged. Usually fatty degeneration; deposition of iron in outer zones of lobules in large quantities.	Small. Usually or deposition of yello
Spleen	Enlarged. Deposition of iron granules throughout	Enlarged: generally
Kidneys	Enlarged; very pale. Deposition of iron granules in cells of cortex. Urine pale, darkens on standing, often albumin; ethereal sulphates increased.	Enlarged; pale Urine normal, albu
Brain	Pale, bloodless; often minute hæmorrhages	Pale. Membranes irritation.
Bone Marrow ...	Sometimes great hyperplasia; megalo- and myeloblastic degeneration of embryonic type; sometimes great diminution of fat; rarely abscesses.	Vessels obstructed gelatinous in long
Duration	Varies according to type. Prodromal period may be very short, but is usually insidious, one to two years. Period of invasion, three to six months.	Period of incubation years.
Types	May be (1) Acute; quickly fatal; usually one month ... ... (2) Sub-acute with severe relapses (six months). (3) Chronic (two or three years).	May be (1) Acute, (2) Chronic, (3) Acute o (4) Abnorm
Termination	Almost always fatal. Generally effusions, ascites, &c., followed by exhaustion and syncope.	Spontaneous cure n In unfavourable cas of lungs, death fro

ANCHYLOSTOMIASIS	SPRUE
edematous; often, history of "water itch" on : and back; red nodules (gourmes).	Pale, muddy complexion; rarely pigmented or patchy.
ıl; very irregular in intensity and type; in inter- tly increased.	Occasional attacks of subacute interrupted fever; temperature usually subnormal.
. ...	Stomatitis almost invariable; vesicles, ulcers, aphthæ, and fissures.
Catarrhal enteritis invariable. Anchylostomum varying numbers, from one to several hundreds; intestinal parasites—trichocephalus, &c. Swel- .nds. Bowels irregular, sometimes mucous diar- inate constipation; Anchylostoma ova invariably d Charcot-Leyden crystals frequently.	Not affected at first. In secondary stage catarrhal gastritis and enteritis, with denudation and ulceration, followed by atrophy of glands and other tissues. Parasites not specific. Diarrhœa at first of bilious type; then secondary, with large fermenting dejecta; occasionally choleraic.
ness, epistaxis. Moderate reduction, R.B.Cs.)0 c.mm.), Hb 27-15 per cent. Normoblasts and , microcytes very numerous. Leucocytes slightly ease of eosinophiles (9-70 per cent.) and mono- : of neutrophiles.	Palpitations and cardiovascular symptoms in advanced stages only. Moderate reduction of R.B.Cs. (3,000,000 to 2,000,000); decrease in Hb; no poikilocytosis or alteration in cells. Leucocytes reduced, with increase of large mononuclears and eosinophiles; coagulation slow.
non	Not affected.
ation for exertion always a marked symptom. ıbcutaneous fat not notably diminished, usually es, menstruation retarded, irregular, generally l; tendency to abortion.	Always lassitude. No wasting at first; afterwards excessive, principally affecting muscles and subcutaneous fat. Emaciation as disease progresses. Menstruation not affected; no particular tendency to abortion.
›erangement of sensation and co-ordination fre- nvulsions, cramps, exaggerated reflexes, ocular che.	Not affected; reflexes sluggish.
:s muddy	Pupils not affected; sclerotics yellowish; vision weakened; refraction errors frequent.
bly wasted or degenerated. Force and electric ıced.	Muscles pale; no petechiae; much wasting in later stages; degeneration hyaline, not fatty; myocardium generally affected. Force decreased; electric reactions not altered.
-yellow colour; fatty degeneration; intercellular æmatoidin granules.	At first large, with sub-acute hepatitis; then contracted, due not to degeneration or fibrosis, but to atrophy of liver cells; no deposition of iron or granules has been observed.
le	Enlarged; pale.
... ...	Enlarged; pale.
in later stages	Urine diminished in quantity, great excess of urates; usually no albumin.
erally adherent, with evidences of effusion and	Not affected.
ıasses of leucocytes. Marrow generally red and ıes; yellow and fatty in short; never puriform.	Observations incomplete.
'e to six weeks. Period of invasion, one to eight	Prodromal period generally very insidious; may be five years.
	Period of invasion, usually five to fifteen years.
	May run an acute course, and terminate in six months.
dyspeptic symptoms predominant	May be (1) Acute or chronic; intestinal symptoms predominant.
:h ditto.	(2) Chronic, toxic symptoms predominant.
·onic, purely anæmic in type; toxic symptoms pre- cteric, febrile, maniacal, &c. [dominant.	
frequent	Spontaneous cure not infrequent.
ncreasing marasmus, albuminuria, ascites, œdema xhaustion and syncope.	In unfavourable cases, increasing weakness from toxæmia and want of nutrition; marasmus, exhaustion; death from syncope.

duration, the patient probably recalls the fact that, long before, irritable points had occasionally developed in the mouth and on the tongue, but that he thought nothing of them, and, though they continued to come and go, they always got well of themselves. If he applies for advice at a more advanced stage, he says that latterly this spontaneous subsidence of sores and vesicles had not taken place. On the contrary, after an unusually protracted and irritable period of eruption, they seemed to get worse; itching had been replaced by stinging and smarting, and he found that certain articles of diet increased the irritation and discomfort. If seen still later, the condition is that his food, unless it be of the most bland and insipid character, burns and stings him; on attempting to take vinegar, relishes, sauces, curries, or pickles, he suffers acute pain. Lime-juice, spirits, wine, or aerated waters are intolerably irritating; he is unable to smoke; in many instances he cannot even take tea or coffee without suffering. His fare is reduced to a dull and uninteresting repetition of unseasoned meats and insipid sops; and he experiences much uneasiness and annoyance at this enforced restriction of savoury food. When, in such a case, the mouth is examined, the tongue is seen to be redder and smaller than usual, and the mucous membrane appears to be abnormally smooth, dry, and glistening. There is no general rawness, but, in places, there are congested and abraded patches, aphthous plaques, and, frequently, excoriations and fissures. These latter are mostly situated on the tongue; they are of varying depth, and usually longitudinal in direction. The dorsum, normally soft and velvety, and thinly coated with fur, is bare and denuded. On its edges, or near the tip—the sites of the fungiform papillæ—one or two flaccid bullæ of herpetic type are generally apparent. The patient recollects no particular tenderness or inflamed patches precedent to the formation of the vesicles. At first the blebs were

very small—not larger than a No. 9 shot—but they grew in about a week to the size of a pea, when, if not already accidentally ruptured, they broke down, leaving shallow, ragged, ulcerated sores. Sometimes these ulcers healed without delay, and a fresh crop of bullæ appeared, but more often the base of the vesicle persisted as an indolent and angry patch.

In most cases of Sprue these characteristic vesicles are not numerous, two or three being an average number; but sometimes they develop in large quantities, and appear in successive crops. Their favourite site is, as has been seen, on the dorsum and tip of the tongue, but they are sometimes situated on its lower surface, especially near the frænum; they are occasionally seen, too, on the gums and on the buccal mucous membrane, and more rarely on the palate, fauces and tonsils. The congested patches from which they originate do not, however, invariably tend to effusion; in many cases they remain as irritable sores on the mucosa, and are then indistinguishable from the lesions left by the ruptured vesicles. If one of the little blebs be pricked by a needle, the fluid which it contains is found on examination to resemble ordinary blister serum. Dried on a cover-glass and stained, the film shows numerous cocci, apparently of the ordinary suppuration varieties, but neither by this nor by other methods can any evidence of pathogenic microbial life be found.

Coincidently with the formation of these vesicles an extensive desquamation of the lingual and buccal epithelium takes place. Here and there it peels off in flakes, leaving abrasions on which are numerous bleeding points; more often it is uniformly shed, until the whole of the inner surface of the mouth is gradually denuded of superficial covering. This destruction of epithelium is at the same time attended by attempts at repair, and there is rapid proliferation of young epithelial cells, which themselves,

however, soon decay and die. In consequence of these changes the mucous membrane assumes the smooth and polished appearance which has been already noted, and which is characteristic and almost diagnostic of sprue. The tongue becomes still more shrunken and contracted, while cracks and fissures indent its upper aspect; sometimes these are mere involutions of the mucosa, but not infrequently they are true solutions of continuity, and they then persist for many months as indolent and exquisitely painful sores.

The development of these mouth lesions is accompanied by a persistent and continued accumulation of mucus in the fauces. The secretion is so viscid and adhesive that it is a matter of difficulty to clear the throat, and, especially at night, mucus forms in such quantity as to induce violent retching. This glairy fluid is an almost constant concomitant of all the stages of sprue, and long after an apparent cure it may remain as a "memory" indication of the former presence of the disease.

In common with the other signs of Sprue, the mouth lesions run a peculiar progressive and regressive course. At times they disappear entirely; after persisting for weeks, or it may be for months, the ulcers suddenly heal without treatment; the angry patches fade; the tongue resumes its moist, soft, normal appearance; filiform papillæ again clothe the dorsum. Then, after a considerable lapse of time, possibly without obvious cause, but, more frequently, in consequence of an excess or indiscretion in diet, vesicles, aphthæ and denudation slowly recur. And so, through the whole duration of the disorder, sluggish but apparently inevitable relapse alternates with partial or entire subsidence of symptoms.

The primary stage of Sprue may be of short duration—only a week or two—or it may be prolonged, without manifest extension

of the disease, for three, four, or even five years. If, during this time, a general examination of the patient be made, it is found that the temperature is normal, or subnormal; there is no marked weakening or wasting, no acceleration of the pulse, no albuminuria, no engorgement of the spleen. The appetite is good, the intestinal action probably normal; and the patient says that beyond an irritable mouth and a feeling of lassitude there is nothing the matter with him. It should be noted, however, that at this period there is usually some tenderness and enlargement of the liver. The increase in size is not great, but it is constant and definite, and it is interesting, in that it is preliminary to a contraction which is one of the most marked characteristics of the later stages of the disease. The enlargement is uniform; the edge of the liver may usually be felt under the costal margins; it is rounder and harder than normal, and about an inch lower. The physical signs are those of subacute hepatitis, but there is still, usually, no rise of temperature. Soon after, there is evidence of œsophageal invasion. Sensations of burning and choking are felt along the track of the tube; it is obviously inflamed, and deglutition gives rise to acute pain. Still a little later, symptoms of acid dyspepsia appear. The patient says that his food—and it is a correct statement of fact—ferments in his stomach. After meals, especially after breakfast, he has indigestion, distension, and discomfort; heartburn, with violent, sour eructations, is constant. He vomits occasionally, and the bowels are constipated or irregular, although at this stage there is, usually, no diarrhœa. On examination no gastric or intestinal tenderness, or evidence of local inflammation, can be made out. Then, after a period during which there is repeated subsidence and recurrence of these symptoms—which may be short, but which often extends to several months—a distinctive type of diarrhœa sets in. In the early morning, usually between 4 and 6 o'clock, the patient

is awakened by spasms of intestinal pain, and two or three motions are passed with much flatus and, occasionally, tenesmus. The dejecta are copious and loose, strongly alkaline, and of a dark green, almost black, colour. Generally, as the morning advances, the diarrhœa ceases, and there is no call to stool for the rest of the day. The purging is followed by a sense of relief, and on getting up, the patient feels better, and he has an improved appetite.

If a portion of fæcal matter be removed from one of these dark-coloured stools, it will be found on examination to consist largely of mucus and bile. On the addition of a small quantity of dilute hydrochloric acid, mucin is precipitated in thick, curdy flakes, and the colour changes to a deep yellowish-brown. Under the microscope there is nothing characteristic to be noted.

This preliminary diarrhœa would seem to be a constant and characteristic symptom of Sprue. It may vary in severity and duration, and it is frequently overlooked or forgotten by the patient, but in most cases it is remembered clearly enough as an incident which at the time occasioned some concern. There is nothing to indicate whether it is of hepatic, pancreatic, or intestinal origin; whether it is an excessive secretion of bile, stimulated by congestion of the liver with spontaneous efforts at relief; whether it is due to defective action of the pancreatic juice in the resolution and destruction of the bile; or whether it is caused by a failure of the absorptive function of the lower bowel.

After some days, generally ten or fifteen, the bilious diarrhœa gradually subsides and ceases. There may then be a few weeks or months of normal health, with apparently normal dejections; or there may be a like period of indifferent health, with constant dyspepsia and occasional attacks of acute diarrhœa, sometimes almost choleraic in severity; or the patient may almost immediately exhibit the secondary, which are also the most familiar, phases of

his disorder. Besides the persistence of the mouth symptoms, this stage of sprue is characterized by a definite type of secondary diarrhœa, a marked diminution in the size of the liver, and a peculiar form of dyscrasia.

The diarrhœa of advanced sprue differs widely from the bilious discharges that denote the earlier stages of intestinal invasion. There are usually six or eight calls to stool daily, which, though still frequent in the early morning, are more evenly distributed over the twenty-four hours. They occur at all times; in the evening, during the night, often immediately after meals. The dejecta are loose, bulky, pultaceous, almost devoid of bile pigment; the colour not, however, the pale clay tint of obstructive jaundice, but a dirty brownish-white, which, with their yet more characteristic gaseous, fermenting consistence, gives them an appearance that is unmistakable and almost pathognomonic. Fermentation is always prominent; when semi-solid, the stools are permeated by gas bubbles; when liquid, they are frothy. Their size and quantity are especially remarkable. Mucus is seldom apparent; blood, in streaks and patches, is occasionally seen, but it is always fresh, and is never mixed with fæcal matter. If the patient is taking meat and ordinary diet, the dejecta are extremely offensive; when he is on farinaceous food they are less so, and a change to milk and fruit quickly renders them almost odourless. As a rule, they are markedly acid in reaction, and the acidity increases with excessive purging. This fact, to which attention was first directed by Dr. THIN, is now a well-established clinical feature of sprue. With the exacerbations of diarrhœa, there is, usually, some abdominal tenderness and discomfort. Generally, during a remission of symptoms, pain is inconsiderable, or it may disappear altogether, but with their recurrence, and especially after some exciting cause, such as a chill or the transit of undigested food through the intestine, it may be

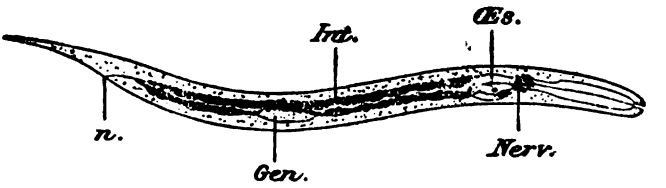
intense. In character, it is griping and twisting, and spasmodic attacks of colic are not infrequent.

The essentially chronic and undulant nature of sprue is exemplified by this characteristic flux perhaps better than by any of the other phenomena. When the disease is left untreated, the diarrhœa may, and often does, continue irregularly for an indefinite number of years. At times it subsides; there are but one or two motions a day; the mouth ulcers heal; the dyspepsia improves; the appetite is good; and hopes arise that a complete and speedy convalescence is at hand. But some indication that the disorder has not been eradicated always remains, and it is obvious, although the patient says he is better, and although all the urgent symptoms have been stayed, that this apparent improvement is not even a first step on the road to recovery. Unmistakable evidence of the persistence of sprue is to be found in the fact that, though otherwise apparently normal, the dejecta are deficient in colour, and that they are still too copious and bulky; the patient is also unnaturally susceptible to cold, and, with little or no provocation, there is continued tendency to attacks of diarrhœa. A slight chill, a trivial error in diet, a little over-fatigue, are sufficient to induce purging, which may be slight and transitory, or violent and persistent, but which is almost always attended by a recrudescence of the mouth sores and other characteristic symptoms.

The dejecta in sprue, and their relations to the processes of the disorder, have naturally been the subject of much careful chemical and histological investigation, but the results are, so far, of little practical moment. The important questions as to the amount of bile and fat present in the fæces, and the explanation of their characteristic colour, will be discussed in the chapter on pathology. But microscopical examination of the dejecta should never be neglected. Apart from the possibility of acquiring further know-

ledge as to the essential nature of the disease, routine examination of the fæces is necessary in sprue, as in all other tropical disorders, in order to determine collateral infections by parasitic entozoa, and thus to afford indications for preliminary treatment.

Intestinal worms, themselves of no material import either in the causation or symptomatology of the disease, are found in about 30 per cent. of all cases of sprue. One of the commonest, especially in those instances where the disorder has originated in Cochin China, Siam, and Malaya, is *Strongyloides stercoralis* (syn.



Rhabditic embryo of *Strongyloides stercoralis* (*Rhabdonema intestinale*, *Anguillula intestinalis*). × 228. (After Looss.)

Rhabdonema intestinale), its presence being indicated by an enormous number of immature forms which are discharged with the dejecta. Under a low power, these embryos are easily identified; they are about from 0·2 to 0·4 mm. in length, and ·01 to ·02 mm. in breadth at the thickest part—just behind the rounded nozzle—from which the body tapers evenly, to end in a fine point at the tail. They are very active and dash through the liquid fæces across the field of the lens with great vigour.

The adult worm—a nematode of the Angiostomidæ family—burrows in the mucosa of the duodenum, and the parasites seen in the dejecta are rhabditic embryos—phases in the larval development of an alternate free-living generation—the progeny of which

ultimately reach another host after a further metamorphosis. Originally discovered in Cochin China by NORMAND in 1876, and described under the name *Anguillula intestinalis*, this worm was considered by him to be the pathogenic agent of the endemic diarrhœa of that country, but its presence is now known to be merely adventitious, and to have no essential significance in the causation of the disease.

Infection by *Anchylostomum duodenale* is also common, the presence of this nematode being frequently associated with that of *Strongyloides*, and in such a case the ova of the former parasite are prominent objects in the dejecta. The preliminary diarrhœa of sprue generally clears away ascarides and thread-worms, and their eggs are, in consequence, seldom seen, but the ova of these and other more permanent entozoa should always be looked for.

Under higher powers of the microscope, epithelial *débris* may be observed in unusual quantity, blood corpuscles are occasionally to be noted, and micro-organisms are seen to flourish in excessive profusion and variety. Occasionally the stools appear to consist almost entirely of bacterial growth; in portions of them some particular bacillus may frequently be found in extraordinary exuberance, and, apparently, almost in pure culture. Such colonies are usually met with in the latter part of the voided matter; seemingly they have come direct from the intestine; and it is almost natural that, for the species of which they are composed, a pathogenic *rôle* should in many cases have been claimed. One special form has been isolated. It is somewhat like the anthrax bacillus, but is larger, has flattened ends, is motile, and stains by Gram. It grows freely on gelatin, with free formation of gas. Confirmation of any ætiological function is, however, lacking. It is further stated that, though rich in micro-organisms, there is a wide difference between the bacterial flora of sprue dejecta

and that of normal fæces. *Bacillus coli communis* is said never to be present in the usual quantity, and it is sometimes so scanty that it may actually be a matter of difficulty to find it. Other undetermined saprophytes, however, take its place and more than make up for the deficiency.

These observations share to the full the difficulties and uncertainties incidental to intestinal bacteriology, and in common with much of it, the results that have been obtained are of little practical value. It may be taken as settled that, in sprue, no micro-organism has yet been isolated which has any claim to be regarded or even reasonably suspected as being pathogenic, that the microbial life consists principally of putrefactive bacilli, which live at the expense of the normal flora, and that the changes in the intestinal contents can only be described by the general and unsatisfactory term—"fermentation."

In the majority of instances, even during the periods of subsidence, and although the patient confines himself to a suitable diet, the second stage of sprue continues to be marked by more or less continuous dyspepsia. Digestion is rarely satisfactory, or unaccompanied by uneasiness, distension and abdominal uncertainty; flatus is persistent; the appetite may be entirely lost, or it may be exaggerated and capricious. Often there are spasms as of acute hunger, and, although fully conscious of the distress that must necessarily be consequent on a large or unsuitable meal, the patient gives way to an irresistible impulse to consume large quantities of food that is obviously deleterious. But, in their tendency to augment and to relax, these symptoms follow the more acute phases of the disorder, and though dyspepsia is the rule, not only during the course of the disease, but long after its supposed cure, in many cases there are not infrequent intervals of comfort and fairly satisfactory digestion.

One of the most prominent physical signs of sprue, at this stage of the disease, is the marked diminution of the area of hepatic dulness. If the liver be examined, it is now found that the tenderness and other evidences of engorgement which characterize the early period have entirely disappeared, and that they have been replaced by a marked contraction. The shrinkage is uniform; there are no nodules, unusual hardness, or loss of regularity in outline. The edge of the liver cannot be felt below the ribs. If a perpendicular line be dropped (in the erect posture) from the centre of the axilla, it meets, at the eighth rib, a dull area, which ends at the bottom of the ninth, or top of the tenth, rib. The upper limit of absolute dulness is, therefore, somewhat below, the lower considerably above the normal level; the length of the line being thus reduced from the usual four and a half to three or even two and a half inches. Careful percussion further shows that this decrease denotes a genuine contraction, and that it cannot be accounted for by inflation of the intestines. The shrinkage of the liver gives rise to no pain or discomfort, and there is, usually, no objective evidence of obstruction to the circulation.

Concurrently with the development of these secondary symptoms, there are obvious indications of the advent of a definite form of toxæmia. Failure of nutrition comes on insidiously and gradually, so much so that it may scarcely be noticed for two to three months after the dejecta have become colourless; but, sooner or later, it is found that the patient is losing flesh. The skin is flabby and loose; the muscles soft, and smaller than usual; those of the upper arm and leg, notably the deltoid, biceps, and calf muscles, being especially lax and shrunken. The subcutaneous fat is diminished, and the connective tissue empty and inelastic. There is always loss of weight; sometimes it is insignificant, but in most cases it is considerable, and occasionally it is very great.

On further investigation, it is found that there is anæmia, and that it is of a definite kind. The blood coagulates slowly; there is marked diminution in the number of the red-blood corpuscles—usually to two or three millions per cubic millimetre—and there is an increase in hæmoglobin. The colour index is high. There is no poikilocytosis, no vacuolated or nucleated red cells. If we accept the differentiation of CABOT, the type of anæmia is therefore secondary, and indicative of an intoxication. It is, indeed, such as might be expected to follow the absorption of a toxin which directly destroys the corpuscles in the circulation, and is akin to that seen in lead and arsenic poisoning, chronic dysentery, cirrhosis of the liver, and anchylostomiasis. Relatively to red corpuscles, the leucocytes are considerably augmented in numbers, the proportion being about 1 to 400. There is, however, no absolute leucocytosis; on the contrary, the white cells would appear to be somewhat reduced, averaging 6,000 per cubic millimetre. The relative proportion of large mononuclear and eosinophile cells is greater, of polymorphonuclear less, than normal; while lymphocytes remain about normal. An average of twenty-two differential counts, in different cases, in which there was no history of malaria or anchylostomiasis, gave :—

Polymorphonuclear	56	per cent.
Large mononuclear	16	„
Lymphocytes	20	„
Eosinophiles	8	„

So far as I can ascertain, the results of blood-counts are not influenced by the return of the patient to a colder climate, and these absolute and relative changes persist throughout the whole course of the disorder.

Like other symptoms of advanced sprue, the marasmus peculiar to the disease is characteristic and unmistakable. The complexion

is sallow and muddy, the expression listless and careworn, the eyes dull, the sclerotic dirty white. There is a tendency to patchy pigmentation, notably below the clavicles, between the scapulæ, on the nates, and on the interior aspect of the thighs. There is a marked disinclination for exertion, and lassitude is intense. The urine is scanty, high-coloured, and loaded with urates. The pulse is usually slow and soft, often intermittent or irregular, occasionally rapid, always of very low tension. The skin reflexes are frequently abolished; the deep are sluggish, and of diminished excitability. Though the rest of the body may feel uncomfortably hot, and perspiration be excessive, the feet and hands are cold and clammy.

In neglected and unfavourable cases these symptoms are accentuated. Emaciation is extreme. Listlessness passes into apathy; the skin hangs loose and flaccid; bedsores form readily. The lips are dry and cracked, often covered with sordes and aphthæ. The circulation weakens; the pulse increases in frequency, and shows marked irregularity and lack of force; generally there is albuminuria and œdema of the feet. Soon the abdomen becomes more inflated; the diarrhœa excessive, watery or choleraic in character, and indicative of total failure of digestive power. With the approach of death the prostration is augmented, the distension of the abdomen subsides, and purging ceases. The vital powers are gradually lowered until they are exhausted; and the fatal termination is the result of heart failure, the patient usually retaining his mental faculties to the last.

This, however, even without treatment, is happily not the invariable termination of sprue. A considerable proportion of cases pass into a latent condition, and though always liable to gastro-intestinal derangements, the patients enjoy fairly good health, and live for many years without any symptoms of toxæmia. In a still larger number of the cases that are left untreated, the dis-

order is protracted indefinitely, its urgency at times abating, at times increasing. But when toxæmia is once established, if treatment is not prompt and effective, there is little hope of averting a fatal issue. It is not too much to say that the patient's life depends on the early recognition of this condition, and that its importance, as an indication for prognosis and treatment, cannot be exaggerated.

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It will thus be seen that the usual course of sprue may, broadly speaking, be divided into three periods or phases, each of which has its own characteristic manifestations. They are, first, the prodromal stage—of variable duration, but extending, not infrequently, to five years—during which the lesions are mainly limited to the mouth, tongue, fauces and œsophagus; secondly, the period of gastric and intestinal invasion, of shorter duration, but lasting usually from six months to two years, the chief symptoms of which are dyspepsia, with a preliminary bilious flux, followed later by characteristic and pathognomonic diarrhœa, with marked diminution in the size of the liver; and thirdly, the period of marasmic toxæmia. During any of these stages, except the last, the disorder, even without treatment, may abort or subside, remaining latent for months or years, or being, to all appearance, cured. Further, in each of these periods the symptoms peculiar to it may be accentuated, and may then become the predominant feature of the disorder, often to the relief or suppression of those which are characteristic of other stages.

Again, though sprue may thus, with reason, be subdivided on a basis of duration or phases, a division into various types or classes, such as "mouth sprue," "intestinal sprue," "wasting sprue," is artificial and misleading. Strictly speaking, there are no varieties of sprue; a distinction exists only in the varying severity of the different manifestations, or of the incidence on different organs, and this variation is common and usual.

Such are the intestinal and toxæmic phenomena of sprue. Clinically, they are the most important indications of the presence and nature of the malady, but certain of the minor symptoms and effects should also be noticed.

TEMPERATURE.—Sprue has no marked influence on the temperature of the body. If the temperature be taken regularly throughout the whole course of the disorder, it will be found, as a rule, to be subnormal—about 97·5° F. both morning and evening—but at irregular and ill-defined intervals there are, in most cases, short periods of feverishness, lasting for a day or two, generally so slight as to cause but little discomfort, and subsiding spontaneously. Occasionally the fever is somewhat more pronounced, the thermometer indicating 100·5° or 101·5° F., but there is nothing definite or characteristic about the curve, and these periodic increases have no marked relation to the exacerbations of the disorder. If higher temperatures are seen, it may safely be concluded that they are not dependent on any of the usual processes of the disease, and that some complication has arisen.

NERVOUS SYSTEM.—In sprue there is no marked interference with the functions of the motor nervous system, but some general deterioration is usually evident. The reflexes, both superficial and deep, are sluggish; the knee-jerks, especially, being retarded, and elicited with difficulty. In two instances, I have seen sprue complicated by peripheral neuritis of the lower extremities. As is usual in similar cachexiæ, the organs of special sense are impaired. Acuteness of hearing and vision are diminished, and errors of refraction arise during the progress of sprue with a frequency that does not seem altogether explicable by the fact that the disease is generally one of mature age.

It is perhaps more to the prolonged and harassing nature of

the affection than to any special influence that the mental condition—often so characteristic as to warrant description as symptomatic—is to be attributed. Yet a complete alteration in disposition is a somewhat constant and definite change, and seems to be indicative of more than the familiar irritability of dyspepsia. In chronic cases a characteristic facies is noticeable. Weariness, sourness, listlessness, and depression are together expressed by a visage prematurely faded and wrinkled. The expression is one of disgust combined with infinite boredom. The patient's outlook on life seems to have changed. Heartiness and cheery manners have given place to querulous and fretful discontent. Quite unnecessarily, he worries about his affairs, and he is haunted by vague apprehensions; he is often sleepless, and in the night his anxieties assume alarming proportions. He wants more than his usual quantity of stimulants, and although he asks for advice, he resents admonition or restriction. In these cases treatment is naturally difficult, and the management of the patient calls for resource and adaptability.

THE CIRCULATION.—Marked cardio-vascular symptoms are seldom seen in the earlier stages of sprue, but in unfavourable cases, and when toxæmia is advanced, dyspnœa is prominent and palpitations are frequent and severe. It is evident, however, that the strength of the circulation, almost from the first, is seriously impaired. Throughout the whole course of the disease, there is hyper-sensitiveness to cold; in ordinary English weather, the tip of the nose is generally blue and congested, and a tendency to cold hands and feet is a constant accompaniment of the disorder. There is, too, in many cases, evidence of malnutrition at the extremities; the fingers and toes are numb and cold; the nails are brown, dry, cracked, and scarred by seams and depressions, and the epidermis at their edges is horny and fissured. The patient,

though clad in the thickest garments, complains that he cannot keep warm, and, even in summer weather, he is chilly and uncomfortable. This unnatural susceptibility sometimes persists when other symptoms have been relieved, and its continuance should be regarded with anxiety; for, in sprue, exposure to cold or damp may be followed by the gravest consequences, even long after apparent recovery.

MUSCULAR SYSTEM.—The muscular system is invariably affected. Myalgia is a frequent accompaniment of sprue throughout the whole of its course, and is especially prominent in the later periods. In the secondary stage the muscles are soft, flabby and atrophied, the effects of failure of nutrition being most apparent in those of the upper arm and calf. With the pain and wasting of the muscles, there is often intense lassitude and weakness, and fatigue is induced by the slightest exertion. The joints, too, are stiff, and apparently deficient in synovial fluid, for the patient assumes an arthritic posture, and walks with a prematurely decrepit gait. In the advanced stages of the disease, muscular atrophy is still more general and profound. Under the loose and flaccid integuments the muscles may still be felt, but they are now shrunk to the smallest dimensions, and are soft, pulpy, and devoid of tone. The first sound of the heart is weak, and there is other evidence of myocardial degeneration. Except in paralysis, the electrical reactions are unaltered.

REPRODUCTIVE SYSTEM.—Though sharing, in advanced cases, the general impairment of function, the reproductive system is seldom affected during the earlier and intermediate stages of sprue. In females, menstruation, although scanty, is regular, and, after the presence of the disease has been clearly established, impregnation is by no means unusual. There is, moreover, no marked tendency to abortion, but, as might be expected, pregnancy is always a serious complication.

ECZEMA OF THE NATES.—Among the other accompaniments of sprue, may be noted a characteristic dermatitis of an eczematous type—due, apparently, to the acid discharges, and coinciding with the severity of the diarrhœa—which, commencing round the anus, spreads forwards and backwards along the perineal sulcus, and sometimes over the nates. At first there is a papular eruption, with exudation, but when the inflammation is of some standing, the skin becomes dry, infiltrated, hard, and of a dark red colour. Fissures and small ulcers appear on the indurated surfaces, and occasion much irritation; herpetic blebs are unusual, but the sores and ulcers are not unlike those which form during the later stages in the mouth, and almost suggest that a direct extension of a specific morbid process has taken place through the intestine.

SPRUE SUPERIMPOSED ON DYSENTERY.—Sprue and dysentery are distinct diseases, and owe their origin to different causes; but both are of every-day occurrence in certain parts of the Eastern Tropics, and it is not surprising that they should frequently be seen in combination. In such instances the usual sequence of events is that the illness commences with acute dysentery, which, without evidence of amœbiasis, gradually becomes chronic; that, after some weeks, the dejecta cease to be dysenteric, their appearance now being suggestive of sprue; that about the same time the tongue and mouth are found to be affected by characteristic lesions, and that there are also symptoms of toxæmia. The after-history is usually such as is seen in the ordinary course of sprue. But it is also the case that, in certain localities and in particular outbreaks, sprue assumes a distinctly inflammatory type. The usual progressive and uneventful course of the disorder is then interrupted by intercurrent seizures of dysenteric diarrhœa. In the low country of the Dutch Indies and Malaya this form of sprue is rare, but in the hill districts of Ceylon and Java, and notably in Cochin China,

where they are known as "*crises dysentériques*," these attacks are common and severe. At periodic intervals during what appears to be the ordinary progress of sprue, the patient is seized with sharp abdominal pain followed by tenesmus and the passage of mucus and blood. According to severity, the attacks are of longer or shorter duration, and they may or may not be accompanied by fever; but in Cochin China they usually last about two or three days; the rise of temperature is slight; and as a rule they are easily amenable to treatment.

It is, of course, possible that such seizures may be produced in an otherwise uncomplicated case of sprue by exceptional ulceration in the sigmoid flexure or rectum; but in view of our present knowledge of the causes of dysentery, there can be no doubt that most of them are genuine instances of a double infection. Probably, however, chills and unsuitable food are the important factors in causation, for it is certain that in Cochin China at least occasional dysenteric diarrhœa does not betoken the combination of the two diseases.

When sprue and dysentery occur together, the former, except in fatal cases, being the slower process, outlives the latter, and is then seen as the terminal stage. It appears to persist after the exhaustion and death of the pathogenic agent of dysentery, whether bacillary or amœbic, and is probably responsible for its disappearance.

CHAPTER IV.

MORBID ANATOMY.

ALL pathologists are aware of the doubts and difficulties which, even in well-equipped laboratories, beset the examination of the alimentary canal, and in the Tropics these are emphasized and exaggerated by the rapidity and extent of *post-mortem* change and disintegration. More especially is this true of atrophic and wasting diseases, and of the investigation of lesions associated with them. It is, for instance, often a matter of much difficulty to decide whether some particular variation seen at an autopsy on a case of sprue is morbid or not; whether an alteration in colour or thickness, an apparent loss of epithelium, a deposit, is a process of disease or of decomposition; whether attenuation of the intestinal walls is the result of atrophy, or of their being naturally thin. So deceptive are the appearances presented by developmental depressions and old cicatrices, especially when they are stained by intestinal secretions, that it is sometimes almost impossible to say whether or not there is ulceration; and in many cases loss of continuity can be verified only by the microscope. The conflicting conclusions which have been formed, both as to the morbid appearances and the nature of sprue, and its relation, on the one hand, to catarrhal enteritis, and, on the other, to chronic dysentery, are to a large extent explained by these facts. But it may be said generally that in the alimentary canal the morbid changes in sprue are those distinctive of a chronic progressive subacute inflammation of definite type, followed by degenerative and destruc-

tive changes in the tissues which are chiefly affected. Limited, during the earlier stages of the disorder, to the mouth and pharynx, the inflammation invades in turn the œsophagus, stomach, and intestines, and its progress is marked by characteristic lesions in all of them. Though varying somewhat in the different sections of the alimentary tube, these lesions possess many features in common; they are, for instance, always at first distinctly inflammatory; they invariably appear to originate in reaction to local irritation; they are further characterized by much round-cell infiltration and superficial necrobiosis, and all of them tend to terminate in atrophic fibrosis of the invaded tissues.

IN THE MOUTH the earlier stages of sprue are marked by stomatitis, generally more or less diffuse and subacute. At certain points, notably on the dorsum of the tongue and on the buccal mucous membrane, the inflammation is more active; patches of infiltration of varying size appear in the sub-epithelial connective tissue and push down into the areolar network which covers and separates the muscular bundles; and here and there, where this is most active, serum is effused below the surface epithelium, lifting it up into characteristic blebs and vesicles, which in a short time become distended and burst. With the progress of the disease the epithelium of the mouth desquamates; sometimes the infiltrated patches heal, but more generally they remain as indolent aphthous ulcers; or, becoming organized, they contract and harden. This sclerosis is not merely superficial; the new connective tissue thrusts itself deeply into the underlying muscle, and its contraction marks off the surface into lobes and islands by deep furrows, some of which are simple involutions, while others again are true fissures. On the dorsum the filiform papillæ atrophy and disappear, the fungiform being generally swollen and infiltrated; but there is, usually, no leucoplakia. As a rule, too, in

places there is suppuration and ulceration, and the follicles of the tonsil and the pillars of the fauces may be congested, hypertrophied, and purulent. In unfavourable cases and in the later stages there is extensive denudation of the mucosa; fibrosed patches, raw and ulcerating, cover the tongue, the buccal mucous membrane, and the inner sides of the lips; and points of suppuration develop in the deeper structures, which slowly burrow a path to the surface or unite as sinuses in the subjacent tissue.

Microscopic sections of patches and ulcers show acute subepithelial inflammation, and infiltration by embryonic lymphocytes. The epithelium may be seen peeling off as flaky shreds or as swarms of individual cells, mostly in various stages of degeneration and without nuclei. The filiform papillæ are shed, and the taste buds exposed and denuded, while in the fibrosed patches much new connective tissue is formed from the cell infiltration. Bacterial growth is abundant, but no special micro-organisms have as yet been demonstrated in any of the lesions.

THE ŒSOPHAGUS in most cases, and especially in the later stages, is also the seat of extensive inflammatory change. It is thickened and infiltrated, and there is much denudation of the epithelium with engorgement of the mucosa. Here and there it may be attenuated, patches of congestion appearing through the wasted membrane as localized vascular arborizations. Not infrequently, buds of granulation tissue, readily perceptible to the touch, are seen sprouting up from the submucous coat. The glands are attacked by colloid, sometimes by cystic, degeneration; ultimately they rupture, and, with the membrane itself, atrophy and shrink, the only evidence left of their existence being a few shrivelled pouches and depressions scattered over the denuded and glistening mucosa. Occasionally they remain as foci of necrosis and suppuration.

THE STOMACH is usually unaltered in size. In advanced sprue the walls are atrophied, generally in patches, and especially near the great curvature. The gastric mucosa is pale, marked by points of sub-epithelial hæmorrhage and localized vascular congestion; in chronic cases it is often rough and cirrhotic. On the mucosa, too, are frequently to be seen pigmented patches, obviously a final stage of venous stasis—the "plaques ardoises" of French pathologists—at one time thought to be of diagnostic significance, but now known to be common in many atrophic conditions to which continued local irritation has been superadded. These patches are, however, interesting in that they are especially liable to superficial ulceration, a process almost characteristic of sprue; and their appearance—a dull leaden-coloured raw sore set in atrophied membrane—is unmistakable. Apart from these plaques, there is besides much localized denudation of epithelium, and small circular superficial ulcers—sometimes so minute as to be seen with difficulty—are often strewn over the mucosa in excessive numbers. They originate at the glandular orifices and are most frequent near the pylorus. Rarely, the ulceration is larger and deeper, necrosis reaching down to the muscular coat; but, unlike true gastric ulcers, these sores never become indurated or callous. Sections of the stomach wall, when they can be made in the early stages of the disease immediately after death, show little organic change, but as the disorder progresses the microscope invariably reveals evidence of inflammation and of marked congestion of the vessels supplying the submucosa, the glands, and the muscular coat. There is extensive invasion by an infiltration of round cells, and the connective tissue is hypertrophied and thickened; the gastric glands are displaced from their bases on the muscularis; in more advanced cases, the swollen interglandular tissue compresses and strangles them; their out-

lets are obstructed, their nutrition cut off, and the secretory cells, becoming cloudy, swollen, and infiltrated by fat globules, disintegrate and break down. No renewal of cells or glandular structures thus destroyed appears to be possible, and in the terminal stages of sprue the mucous membrane of the stomach is but an attenuated parchment-like membrane, honeycombed by shallow pits and cicatrices, the shrivelled remnants of gastric glands, and epithelial ulcers. Below the mucosa, as in the œsophagus, buttons of lymphoid tissue are generally to be felt between the stomach walls; in most cases these are swollen and infiltrated follicles in various stages of inflammation. They may subside, or they may become fibrosed and atrophied; sometimes they suppurate, rupturing and forming deep ulcers on the surface or resting as chronic and cheesy abscesses between the deeper gastric coats.

There is nothing unusual in the stomach contents; they are, perhaps, somewhat watery and liquid, and sarcina ventriculi is occasionally to be found in exceptional numbers.

THE SMALL INTESTINE is generally pale, atrophied and collapsed, the mucosa is blanched and colourless; localized vascular arborizations are numerous; the villi, in advanced cases, have disappeared; the soft feeling, as of velvet, which they naturally give to the mucous membrane, is lost, and the surface is smooth and looks as if it had been polished. Patches of stasis and induration, paler, but otherwise not unlike the "plaques ardoises" described as occurring in the stomach, are frequent in the intestinal walls, and are especially numerous in the lower part of the ileum. Their internal surfaces, raised somewhat above the level of the surrounding mucosa, are of a dull, ashy colour, and are thickly studded by minute black points of ecchymosis, and by superficial ulcerations. They have been, not inaptly, termed "shaved-beard patches," from their resemblance to the appearance given to the face by a strong

dark growth having been shaved too closely, and the skin having been abraded in the process. Between these plaques, the attenuation of the intestinal coats is particularly noticeable; in some cases, the walls are so thin as to be almost diaphanous; in others, though structurally atrophied, they are swollen and œdematous. The valvulæ conniventes are especially prone to œdema; if the effusion is considerable, their distended free borders are closely packed together, and they then look not unlike ascarides laid in regular transverse rows round the wall of the bowel. The mucosa is generally tinted by the intestinal secretions; deep red or dark green patches of bile-stained tissue occur here and there, the colour being sometimes limited to the indurated plaques, sometimes to the unaffected or atrophied parts of the membrane. In about 25 per cent. of all cases, ulcers, small, but easily visible to the naked eye, and in considerable numbers, are to be found. When numerous, they are mostly epithelial or superficial, and confined to the upper layers of the mucosa, but occasionally, and especially when solitary or few in number, they reach down into the submucosa, or even to the muscular coat. They are not limited to any particular region or area of the intestine, and have no connection with the agminate or solitary glands. Under the microscope it is seen that, as in other parts of the alimentary canal, the lesions of the small intestine originate in the submucosa. The vascular network of that tissue is congested and distended by thrombi; and when these are of long standing, the pigment of the blood soaks through the vessel walls, and, becoming absorbed by the superficial cells, stains them the peculiar leaden tint that has already been noted. The areolar tissue and lymphatic channels are packed by a dense infiltration of small round cells, which compresses and obliterates the crypts of Lieberkuhn. Not infrequently the lower parts of the crypts escape the strangulation which involves their outlets, and, cut off

from communication with the intestinal canal, persist and are seen on section as cystic dilatations in the submucosa. The villi, too, are invaded by embryonic cell growth; the central lymph vessels and the areolar framework become mis-shapen and distorted by the infiltration; ultimately this is organized and shrinks, and the villi retract and are lost in the general distension of the mucous membrane. The primary effect of these changes is arrest of the blood supply to the mucosa; the surface epithelial cells then lose their nuclei, disintegrate, and are shed into the lumen of the intestine, while necrotic areas, forming where pressure is greatest in the epithelial layer and submucosa, originate the superficial ulceration which is so marked and characteristic a feature of the secondary stage of sprue.

The glandular changes closely resemble those noted in the stomach. The follicles are, at first, swollen and congested; often they are as large as beans, and seem to have some limited mobility between the intestinal coats; the vessels of the lymphatic plexus which surrounds them are tortuous, dilated, and, like the glands themselves, infiltrated by small cells. In the later stages this inflammation of the follicles either undergoes resolution, or a colloid and cystic degeneration takes place. In unfavourable cases suppuration supervenes, and the follicles slough and ulcerate, or persist as foul, encysted abscesses in the wall of the intestine. As carriers of septic matter to these foci, and as distributing channels of infection to uninvaded tissue, the lymphatic vessels of the follicles always play an important part, and in such instances are invariably found to be full of pus.

Except when there is suppuration, the general tendency of all these intestinal lesions is to end in simple atrophy, with absorption and attenuation of the adventitious cell-growth. Fibrotic proliferation is, however, by no means unusual. In such an event, the

SPRUE. BASE OF SMALL ULCER OF INTESTINE. + 55.
The mucosa has been shed, and the dense infiltration of the submucosa is causing it to break down and come away as a necrotic slough. The lymphatic vessels in the centre of the infiltrated portion are full of pus.

SPRUE. BASE OF SMALL ULCER IN INTESTINE. + 350.
Dense infiltration and formation of pus in superficial layers.

intestine becomes pale and leathery; it is hard and tough on section; the vessels and areolar bundles show a true fibrosis, and the connective tissue corpuscles disappear. In some cases where there is no general fibrosis, peculiar cicatrices, in the form of circular depressions, with hard sclerosed edges, are occasionally found on the surface of the mucosa.

IN THE GREAT INTESTINE, also, the morbid changes are extensive and varied, but, in general, they resemble those of the upper part of the alimentary tube. Evidence of preliminary submucous congestion is everywhere abundant. There is similar engorgement of lymphatics and blood-vessels in the submucosa, infiltration by round cells, and destruction and desquamation of the glandular and surface epithelium; there are, besides, corresponding inflammatory and suppurative changes in the follicles; and there is a like tendency to atrophy and fibrosis in the coats of the intestine. Owing, perhaps, to the greater natural abundance of the lymphoid structures, their hypertrophy and proliferation are even more marked than in the small intestine. Excrescences of lymphoid tissue—true intestinal adenoids—frequently form in the submucosa, and project into the bowel; but they vary greatly in size and appearance, and though, in most cases, these growths obviously originate in reaction to irritation, it is difficult to say whether they have any connection with the disease. They are often found in an otherwise healthy colon, and the most that can be said is that in sprue they seem to be unusually abundant. Partly as a consequence of this hypertrophic growth of adenoid tissue, partly on account of the formation of indurated plaques, and partly as a result of cicatricial contraction, there is, in many cases of sprue, marked diminution in the calibre of the bowel. This is usually most apparent in the sigmoid flexure, where the lumen of the intestine may be so constricted that it will scarcely admit a single finger; and, to overcome the resistance which is offered by

this contraction to the passage of the intestinal contents, localized hypertrophies of the muscular coats are frequently developed.

IN THE CÆCUM, COLON, AND SIGMOID FLEXURE, as in the duodenum, jejunum, and ileum, pigmented and ulcerated patches of induration alternate with areas of normal or atrophied intestine. They are, perhaps, more numerous in the cæcum, in the sigmoid, and in the rectum—the preferential sites of hypertrophy and ulceration—than in the colon, where the tendency to atrophic change is more pronounced. If, in the earlier stages of invasion of the great intestine, it has been possible to obtain an autopsy, it will be found that the initial morbid processes incident to the small intestine are accurately reproduced. There are localized venous congestions and arborizations, pigmentation and degeneration of the epithelial structures, and in many cases crops of minute necrotic patches in the superficial layers. It is, however, generally the case that in the large bowel, the inflammation is more catarrhal in character. The mucosa is then covered by a viscid layer of mucus and epithelial detritus, sometimes of great thickness and tenacity, which, when sponged off, leaves a raw surface, covered with points of hæmorrhage and superficial ulcers. These latter closely resemble the ulcers of the small intestine, and have nothing in common with the profound and extensive destruction of tissue which is characteristic of chronic dysentery. It is, however, the case that in sprue, though during life there were no dysenteric symptoms, large and deep ulcers, apparently dysenteric in nature, and generally solitary, are occasionally found in the colon ; and to this circumstance much of the confusion which has arisen in the differentiation of the two diseases is to be ascribed. As a general rule, these solitary deep ulcers have no relation to dysentery ; they originate in suppuration of the follicles, which, as has been seen, is a common incident of sprue, and not in dysenteric inflam-

mation of the submucosa; and, in determining their origin and nature, the simplest, and indeed, the only way is to decide each case upon its own merits. When co-existent with other sprue lesions, when they are few in number, and particularly when they are solitary, ulcers are, in all probability, part of the morbid processes of that disorder; if, on the other hand, they are found in considerable numbers, and if there is evidence of previous acute inflammation, they point to a mixed infection. But sprue and dysentery are distinct diseases, and their morbid phenomena are usually clearly differentiated.

In the light of recent researches as to the *rôle* of the peritoneum in the production of intestinal toxæmia, the pathology of the membranes and secretions will, doubtless, in future receive closer attention, but at present little is known either of their morbid changes or bacteriology. The subject—at least so far as sprue is concerned—is attended by many difficulties, of which the extreme chronicity, the consequent liability to collateral infections, the uncertainties of *post-mortem* appearances, and the obstacles to the experimental reproduction of the disorder, are not the least. A record of numerous examinations of the abdominal cavity in sprue shows little that is constant beyond wasting and marked loss of omental fat; the appearances are such as might almost be presented by an equal number of selected autopsies on cases from the medical wards of a general hospital. There are in some instances adhesions, effusions, and plastic inflammation; in others, none of those lesions; in sprue of pronounced cachectic type there is generally an excess of peritoneal serum. When the disease has been of long standing the peritoneum affords evidence of chronic inflammation; to the naked eye it often appears thickened and infiltrated, microscopic sections indicating that, perhaps, this is invariable; and there is generally some sero-purulent effusion.

THE MESENTERIC GLANDS are swollen, hard, and pigmented; not infrequently, they are atrophied and show fibrotic changes.

In the later stages of sprue, THE LIVER is usually much diminished in size. From a normal weight of 50 ounces in a man of average build, it is reduced to 35, 30, or even 25 ounces, the loss of weight in the gland being relative to the general emaciation of the body. Externally, there is no alteration in shape or appearance; as a rule, the section is yellowish-green, pale and anæmic. Under the microscope, the diameter of the lobules is seen to be decreased, but there is no increase of connective tissue, and the condition appears to be one of simple atrophy. In the intermediate stages of sprue the vascular congestion of the liver incident to the first period is not seen; on the contrary, the vessels are thin, empty, and attenuated; but later, and especially near the end, there seems to be considerable engorgement and infiltration, with proliferation of nuclei in the vessel walls—a change which closely resembles the hepatic reaction to the irritation of other toxæmic products. The morbid processes in the liver occur, therefore, in the following sequence: first, a general subacute hepatitis; secondly, a stage of progressive simple atrophy, due to insufficient nutrition; and thirdly, in the shrunken and contracted organ, a further inflammatory reaction, caused by the presence of absorbed toxins in the portal circulation. There is rarely any fatty degeneration of the liver in sprue, and no deposition of hæmotoidin or iron granules has been observed. Abscess probably never occurs independently of dysentery; nor atrophic cirrhosis, unless there is alcoholism. Hypertrophic cirrhosis, due apparently to the same cause, and masking the actual contraction, has been seen as a complication of sprue.

THE PANCREAS is usually pale, indurated, and unaltered in size. In some cases, however, it has been reported as showing extensive morbid changes, all of which, apparently, commenced in inflammation—an acute parenchymatous pancreatitis—the terminal appear-

ances being local suppuration, myxomatous degeneration, and caseation. But it is by no means certain that these processes were dependent on, or pathologically connected with, sprue, and the reports of the examination of the sections give rise to the suspicion that there was a concurrent infection of tubercle. Certainly, lesions of the pancreas are not of invariable or even of common occurrence in sprue; and though, in view of the symptoms, statements as to coincident disease of that gland are of much interest and importance, assertions as to their significance are, so far, entirely without confirmation.

THE KIDNEYS in sprue are generally normal, but sometimes they are pale and large; more rarely, they are contracted and granular. The morbid changes occasionally noted seem to have no relation to the disorder.

IN THE THORAX, the serous cavities, as in other cachectic conditions, contain, in most cases, an excess of fluid, but are otherwise unaltered. The HEART is generally small and soft, rarely dilated. It is pale and blanched in colour, and unusually lax and flaccid. The loss of muscular tonus is remarkable. If, when removed from the thorax, it is held up by the great vessels, it often fails to retain its shape, and the ventricular walls not infrequently collapse under their own weight. Microscopic sections show the muscle fibres to be hazy and ill-defined, the striation indistinct, and the general appearance suggestive of hyaline change. Pigmentary degeneration (brown atrophy) has also been described, but it is questionable whether these changes have a direct relation to sprue, or are merely due to prolonged tropical residence.

Morbid alterations in the LUNGS are unimportant; terminal œdema and congestions are usual, and fat is absent.

THE BRAIN AND NERVOUS SYSTEM are, so far as is known, unaffected in sprue.

CHAPTER V.

PATHOLOGY.

THE problem presented to the pathologist by the symptoms and morbid appearances of Sprue is complex and difficult, and as yet, the solution is by no means complete. To some extent, the explanation of the various phenomena rests on an assured basis of ascertained fact, and, in so far, is satisfactory; partly it is, and will probably remain, conjectural. But although enquiry must therefore be, to a great extent, speculative, it does not necessarily follow that it will be profitless, or without result in the elucidation of the nature of this tropical flux. There is, moreover, reason to believe that the definite and idiopathic character of several intestinal disorders of tropical origin affords a field of unusual promise for pathological research, and that further study of their phenomena may throw light on the obscure problems of abdominal auto-intoxication in general.

The principal points for determination seem to be :—

First—Is the infection of sprue specific and pathogenic, or is the disease merely an expression of degenerative changes originating in the alimentary canal, and resulting from climatic or other influences? Secondly—What relation exists between Sprue and similar affections, such as dysentery, hill diarrhœa, and other intestinal disorders prevalent in the Tropics? Thirdly—What indications are there as to the nature of the characteristic signs of the disorder —the atrophy of the liver, the different types of diarrhœa, the

colourless dejecta, the anæmia, the emaciation? And Fourthly—How are the toxæmic symptoms to be explained? In what way are they produced, and by what route does the poison reach the systemic circulation?

THE NATURE OF THE INFECTION.—In view of the fact that no specific micro-organism has as yet been demonstrated, exact statements as to the nature of the condition are impossible. But the indications are obvious, and the only conclusion that it seems possible to draw from the symptoms and morbid changes is that the disorder is due to a specific protozoan or bacterial infection, which gradually spreads from above downwards through the alimentary canal. No other explanation would appear to be compatible with the actual phenomena of sprue. The preliminary invasion of the mouth, the chronicity, the constant and definite character of the sores, the submucous infiltration and congestion, and especially the gradual and progressive extension, are, otherwise, almost, if not altogether, inexplicable.

And so through the stomach and intestines: no theory except one of microbial infection will satisfactorily account for the peculiar inflammatory change, the ulceration, the glandular reaction. Intestinal lesions like those of sprue are found only as a result of microbial growth; they have never been seen, so far as we know without it; and in widely separated morbid processes such as, tubercle, where a microbial origin is certain, and summer diarrhœa and dysentery, where it may safely be presumed, their character is altogether similar. Further support to this view is given by the geographical distribution of sprue, by the regional prevalence of the disorder within a definite area, by the method of its conveyance and extension, and by the fact that it does not occur in places with climates that are similar to those where it is common.

There are, moreover, rare but well-authenticated instances of

immediate infection. Although the European seems, as a rule, to be able to offer a prolonged resistance to the invasion of sprue, undoubted infection has occurred during a very short sojourn in the area of prevalence. Such a space of time as was occupied by the call of a ship at a port to discharge a portion of her cargo is recorded, by Roux and other writers, as having sufficed for the contraction of Sprue; and it is further stated that in these cases the patients had never before been in the tropics, that they were not more than twenty-four hours in the endemic area, and that the period of incubation was fifty days. Personally, I have never seen an instance of infection after so short an exposure, but there is no reason to doubt that it is possible. And, if it is so, the evidence for specific microbial infection is more than presumptive.

The proposition that sprue is merely indicative of premature degenerative changes, or that it is due to some alteration in the life conditions of bacteria normally present in the intestine, by which their toxins become more virulent and more easily absorbed, would seem to be sufficiently disproved by these prominent clinical facts, but if further evidence is necessary, it may be found in the circumstances that the initial morbid process is, almost invariably, in the mouth and not in the intestine; that toxæmia, which might reasonably be expected to be an immediate indication of such a change, is a late and not an early symptom; and that the endemicity of the disorder is limited and accurately defined.

Again, were the disease only an expression of deterioration due to climatic influences, it is inconceiveable that there should be such marked divergence in its prevalence in localities that are geographically contiguous, and of practically identical latitude and climate, as, for instance, Shanghai and the ports of Japan. In the former it is an appreciable factor in the sanitary condition of the Settlement, in the latter it is almost unknown. And,

further, were loss of resistance due merely to a prolonged residence in a high temperature, there would seem to be no reason why sprue should not be as common, say, in Central America as in Malaya; or why it should be as prevalent in Shanghai as in Singapore.

THE RELATION OF SPRUE TO OTHER INTESTINAL DISORDERS.—As to the relation of Sprue to dysentery, and the belief formerly held by many of the French physicians in Cochin China, that it was merely a terminal or variation phase of the latter disease, the historical aspects of the controversy have already been noted, but one or two salient features in the differentiation of Sprue from dysentery, and especially from amœbiasis, may be mentioned. Of these, perhaps the most notable is the important clinical fact that abscess of the liver is unknown as a complication of sprue, though in countries where sprue is endemic, liver abscess as a sequel of dysentery is of frequent occurrence. Thus, in Ceylon, during 1904, there were in the British garrison of that island, sixteen cases of dysentery—a ratio of something over 1 per cent. of the strength; and of these, six were followed by hepatic abscess. The latter is, however, an abnormal proportion, the average being, in India, about 1 in 4·5. Of 1,429 recent consecutive cases of dysentery among the white troops in India, abscess of the liver was a sequela in 306.

To compare with this a station where sprue is not endemic, we find that in Algiers suppurative hepatitis occurs in about the same ratio. In the French army of occupation, of 1,001 consecutive admissions for acute dysentery there, 180 were followed by abscess. In Cochin China, 3·8 per cent. of the total mortality in the ten years 1890-1900 was due to suppuration of the liver following dysentery, and this figure approximately expresses the usual proportion of hepatic complications there. Apparently, in

no case did liver abscess follow the endemic diarrhœa of the country; and it is thus obvious that dysentery is by no means infrequent, or mild in type.

In the Dutch Army in the East Indies in 1904, the total strength not being given, there were twenty-three cases of hepatic abscess in Europeans, and two in natives.[1] It would scarcely be necessary to adduce these statistics were it not for the fact that in some tropical settlements, such as the Cameroons and other stations in Central Africa, dysentery in Europeans is but rarely followed by hepatic abscess, and it might have been argued that a similar immunity prevailed in regions where sprue is endemic. As a matter of fact dysentery is even more common in South-east Asia and China than in India, and, as the figures show, the proportion of cases in which it is followed by abscess of the liver is, if anything, higher.

Again, the geographical distribution of sprue strongly favours the view that it is distinct from chronic dysentery, and that it is, besides, essentially a disease *sui generis*. In the medical literature of the West Indies, where chronic dysentery, which has a terminal toxæmia not unlike that of sprue, is responsible for a large mortality, we find no record of mouth lesions, or of bulky, white dejecta, as features of any stage of the disease; nor in the medical reports of the French naval physicians can any mention of these symptoms be traced. It was not until after their experience in Cochin China that they described mouth lesions as being a not unusual event in the course of the disorder which they encountered there, and which they then believed to be dysentery. Further, in Malaya, as in Cochin China, both disorders are common, and it is by no means unusual to see sprue

[1] Janus, 1897-98.

combined with chronic dysentery; but dysenteric dejecta seldom or never assume the characters of those of sprue, unless there are well-marked mouth lesions, and unless there is other evidence that one infection has been engrafted on the other.

In other words: Sprue may be combined with, and thus appear to follow, Dysentery, but in itself it is always a primary, never a secondary, disease. Chronic dysentery — bacillary or amœbic—on the other hand, commences in acute dysentery, and though the attack may be a mild one, it is invariably the first phase of the illness. Yet the differentiation of the two diseases may be somewhat difficult. Apart from double infections, which are frequent, sprue, in certain epidemics and in certain places, assumes a somewhat perverted type, and occasional dysenteric seizures usually occur in the course of the disorder. In Cochin-China, especially, such cases are common, and it is by no means extraordinary that French physicians, in the absence of our present knowledge of the causes of dysentery, should have been doubtful as to their nature. As a rule, however, the following cardinal diagnostic points hold good: In sprue, there is no preliminary acute attack, no excess of mucus or blood in the dejecta, there is no acute pain and tenesmus during their passage, nor is there a tendency to hepatic suppuration. In dysentery there are no mouth lesions and no bilious evacuations, nor, while hepatic abscess is frequent, do we find contraction of the liver, or the characteristic secondary diarrhœa of sprue.

Allusion has already been made, in the chapter on the Literature of the disease, to the connection between sprue and some other forms of tropical flux; the relation of sprue to Hill Diarrhœa will be further discussed in the description of that disorder.

THE NATURE OF THE CLINICAL PHENOMENA OF SPRUE.—One of the most prominent physical signs of sprue is, as has been

seen, a characteristic shrinkage in the normal bulk of the liver, and much ingenuity has been exercised to find a reasonable explanation for this phenomenon.

The following are ascertained facts in the morbid anatomy of the disease: In sprue, the liver, though contracted, is not cirrhosed. There is no marked cellular infiltration, and no increase of fibrous tissue. In microscopic sections, no actual cell necrosis, detritus, or fatty degeneration can be seen, and little is to be made out beyond the fact that both the lobules and the liver cells are diminished in size. The possibility of organic cirrhosis, or of change akin to acute atrophy, being thus excluded, the question arises, To what is the contraction due? Is it to simple want of nutrition, or to suspension of the functions of the gland, and a consequent cessation of storage and transformation of glycogen?

It is more than probable that there is in Sprue a close relation between the degeneration of the epithelium of the intestine and the contraction of the liver, and that the former is, in some degree at least, always precedent to the latter. One of the most important functions of intestinal epithelium is the preparation, by means of self-contained ferments, of the food for assimilation. Thus, if an animal is killed after a copious meal of starchy food, sections of villi show the epithelial cells to be loaded with fat. In like manner, these cells transmute proteid into fat, and they further supply carbohydrate, in excess of what they have themselves metabolised, to the liver cells for mutation into glycogen. It is, moreover, probable that upon the efficient performance of these functions their own nutrition and that of the liver cells depend, and it is obvious that the impairment of the structural integrity of the epithelial cells must be followed by at least a partial arrest of the supply of fat to the lacteals, and of carbohydrate suitable for transformation into glycogen to the liver cells. That the process

of intestinal osmosis is also checked by the destruction of its epithelium (though its removal must increase the facilities for filtration), has been shown by actual experiment.[2] To this stoppage of absorption and transformation of carbohydrates and proteids, systemic malnutrition is but a natural consequence, and with the arrest of glycogen-forming material it follows that, of all the viscera, the liver must suffer first and most severely. Again, results of the treatment of sprue by a purely milk diet lend considerable support to these conceptions of the part played by the intestinal epithelium in hepatic nutrition. When farinaceous carbohydrates are excluded from the food, and an abundance of fat is provided in a condition that approximates the form in which it is normally secreted into the lacteals, the damaged epithelial cells are relieved of a function, which they are inadequate to perform, by their products being thus supplied, as it were, ready-made. The increase of corpuscular richness in the blood, and of the actual dimensions of the liver, that follows a diet of milk to the exclusion of other food, in Sprue, is highly significant; the former is out of all proportion to the amount of nourishment that has been given, and it is, likewise, far in excess of the increase that takes place in similar cachectic conditions where milk has been substituted for a general diet; the latter is marked and constant.

Further, it is the case that starvation of the hepatic cells and consequent contraction of the liver has an important bearing on the production of toxæmia. By an interesting and important series of experiments on the toxin-resisting function of the liver, G. PADOA has shown,[3] that injections of the toxins of *Bacillus coli communis* into the jugular and portal veins of rabbits are respect-

[2] "Human Physiology," Noel Paton. Edinburgh: W. Green, 1903.
[3] Padoa. *Rev. Crit. de Clin. Méd.*, September and October, 1904.

ively followed by different effects; and that, normally, there is a marked and definite resistance in the liver cells to the products of intestinal microbial growth. His results have been elaborated and confirmed by FLEXNER and SWEET,[4] and it is therefore reasonable to suppose that hepatic atrophy is a potent factor in the production of toxæmia. The *rôle* of the liver in controlling intestinal auto-intoxication may thus be assumed to be of greater importance, as an element in the prevention of general infection, than the alleged antiseptic property of the bile in the alimentary canal.

Another phenomenon of Sprue, no less characteristic and remarkable than contraction of the liver, is the apparent absence of fæcal pigment in the dejecta. The subject is, again, one that is full of difficulty, for although many suggestions and theories have been advanced to explain why and how intestinal excreta may, in certain circumstances, apart from Sprue, become clay-coloured, no satisfactory or conclusive solution has yet been found. Our knowledge as to the nature of the colouring matter which is normally present is inadequate and incomplete. The results of recent researches indicate that one or more special fæcal pigments are elaborated somewhere in the lower bowel, but from what substance, by what agency, or in what position this is effected is still a matter of conjecture. It is held, on the one hand, that they are new products; on the other, that they are metamorphosed bile pigments. Yet, though little is known of the physiological, and still less of the pathological, chemistry of intestinal digestion, two cardinal clinical facts as to pigment are fairly well assured; one, that both in non-tropical and tropical disorders the dejecta may be clay-coloured, although abundance of bile is entering the alimen-

[4] Flexner and Sweet. *Journal of Experimental Medicine*, "Experimental Colitis," August, 1906.

tary canal, the other that there may be complete and prolonged absence of bile from the dejecta without jaundice or other evidence of obstruction.

Absence of bile from the dejecta in non-tropical conditions, without jaundice as a sequel, has been fully investigated; it has been the subject of much intricate and involved chemical research, and under the title of "Acholia," one form of it has recently been claimed by Dr. W. B. Cheadle as a distinct disease. Except for the fact that diarrhœa is not invariable, this disorder would, however, seem to be closely akin to, if not identical with, the acholic conditions which have been already noted as being prevalent in all parts of the world, and as being notably common in the tropics.

The results of the analysis carried out for Dr. CHEADLE[5] by Dr. W. H. WILCOX, showed that in every one of his cases of acholia bile pigment and bile acids were deficient, and that in extreme, or, as he calls them, typical instances, in which the dejecta were white, they were altogether absent. In one case, absolutely without other symptoms, there was about 50 per cent. of fat, without evidence of bile pigments or bile acids in the dejecta; and in another analysis[6] undertaken by Dr. SYDNEY MARTIN for Sir LAUDER BRUNTON, only small quantities of unaltered biliverdin, and the faintest indication of biliary acids, could be found in the stools of a patient who had no evidence of illness beyond the fact that he was passing colourless excreta. Without definite information as to the nature of the food that is being taken, statements as to the percentage of fat found by analysis are, however, of little importance, and the only deduction to be drawn from these and other investigations

[5] Cheadle. The *Lancet*, May 30, 1903.

[6] Mayo Robson: "Hunterian Lectures," 1904.

is that almost complete obstruction or suppression of bile without jaundice or other serious symptoms is not only possible, but is by no means uncommon. That in such cases the white colour is largely due to an excess of unmetabolized fat is nevertheless probable, for though the dejecta may be colourless when no food except red flesh is being taken, the presence of fat has been shown to be a constant and definite factor in the production of the phenomenon. CAMMIDGE has further demonstrated the alteration of colour to be due, in many cases, partly to excess of fat which has become crystalline, and therefore more refractive than normal, but partly to a considerable change or diminution in the normal fæcal pigment. There can thus be little doubt that more than one agency is concerned in the elaboration and supply of pigment, but with our present limited knowledge of the chemistry of intestinal digestion, and our ignorance as to the influence of the pancreatic secretion in the formation of residual pigments, no further explanation is, perhaps, at present possible.

The results of the chemical investigation of Sprue dejecta are naturally still more unsatisfactory, and are, besides, at variance upon points that would seem to be almost elementary. To arrive at any conclusion as to the pathological changes that take place, it is obvious that there must first be unanimity as to facts, but this is by no means the case. Estimates by skilled observers of the amount of fat present in the characteristic white excreta of Sprue have, so far, been conflicting; in some cases they went to show that it was abundant; in others, that there was a little, yet in others, none. In view of the definite statements in standard works on physiology as to the uniform quantity of fat normally present in dejecta, the point might be thought to be of some consequence; but it is really one of little practical importance, for it is now known that the amount of fat depends on, and varies with, the food, and that it

is entirely unreliable as an index of disease. Though in some forms of disordered metabolism it may be imperfectly digested, there does not seem to be in sprue any incapacity to assimilate fat; the contrary is indeed true, and, as in other conditions, the quantity present in the fæces depends on the nature of the food that is being taken. If fat is excessive, as in a milk diet, some part naturally remains undigested, though that, too, is the case in health.

Authoritative estimates of the amount of bile would be of still greater significance, but here, also, there is a similar disagreement as to facts. In some instances, analysts have found bile acids to be actually in excess, in the majority of cases they were present in normal amount, though again in others, they were deficient or absent. In all of these the dejecta were colourless.

A further theory which has been advanced is that in sprue the loss of colour is due, not to arrest or derangement of the hepatic or pancreatic secretions, but to destruction of the residual pigments in the great intestine by the failure of the glands in the cæcum to alkalinify, as they do normally, the acid chyme. Some support is lent to this view by the circumstance that in sprue the dejecta are acid, and that the mucosa of the lower intestine is often covered by a dense and viscid layer of mucus, impermeable to the secretions.

It is difficult, however, to avoid the belief that there is a constant and definite connection between the condition of the liver and that of the dejecta. The latter do not assume their characteristic appearance until after the gland has begun to contract, and it is not unreasonable to suppose that diminution in size should be attended by decrease in the secretion of bile. And, although it is the case that when epithelium is intact, and intestinal digestion otherwise normal, reasonable health may be possible in the temporary absence of bile from the intestine, it is otherwise in Sprue.

Owing to the destruction of epithelial cells, there is, so far as carbohydrates and proteids are concerned, failure of zymolysis; these elements of the food consequently remain unmetabolised, and, carrying with them, through the intestine, the unabsorbed fat, they are excreted as the bulky clay-coloured dejecta of the secondary diarrhœa. Further, offering, as they do in their acholic condition, an exceptionally favourable medium for the development of putrefactive bacteria, the invasion of the intestinal contents by these organisms, which, naturally, would be delayed until they reached the great intestine, is anticipated, and bacterial decomposition, with abundant formation of toxins, takes place in the ileum. These toxins are partly cast out by the increased peristalsis and diarrhœa which is set up by their presence, but they are also partly absorbed, and thus induce the most characteristic of all the symptoms of Sprue—the toxæmia of the later stages of the disease.

THE TOXÆMIA OF SPRUE.—Degeneration of the epithelial cells, and the consequent irritable and unsettled condition of the alimentary canal, are necessarily attended by a failure of nutrition, and also by a definite type of anæmia. The characteristics of the latter have already been noted, and there is conclusive proof of the manner in which it arises. But there is abundant evidence that sprue is more than a mere arrest of nutrition; it is, beyond this, a striking instance of perversion of the absorptive function. Toxins are absorbed from the intestinal tract, while the nutritious elements of the chyme are rejected. A distinctive form of toxæmia, of which anæmia is the first indication, appears concurrently with the atrophy and degeneration of the intestinal mucosa, and of all the manifestations of sprue, it is, perhaps, the symptom that possesses greatest interest for the pathologist. The later stages of Sprue present a unique

clinical picture of an intestinal auto-intoxication, definite in type, in origin, and in effect, the marasmus of which is closely akin to the cachexiæ of diseases in which toxins are continuously generated by a definite agency, and reabsorbed into the systemic circulation.

There is, for instance, a large body of evidence that certain affections which, like progressive pernicious anæmia, were long believed to have their origin and pathogenic field solely in the hæmopoietic system, or, like anchylostomiasis, in the direct abstraction of vital elements from the circulation, are, in reality, manifestations of the absorption of toxins generated in the alimentary canal. The list of disorders, which, with more or less assurance, are included in the number of those that thus operate by intestinal auto-infection, is, indeed, becoming a long one. In the case of some of them there can be comparative certainty as to their nature. It is obvious enough, for example, to those who are familiar with the dyscrasia of chronic dysentery that the fatal issue in that disease, no less than in degenerative atony of the colon, is due, in some part to exhaustion caused by the intestinal lesions, but in a far greater measure to the auto-intoxication which results from the absorption of intestinal toxins.

The pathology of other diseases which have been classed as intestinal toxæmias is, perhaps, more conjectural, but it is still highly significant. It has recently been claimed that the protean dyscrasia, beri-beri, is but the systemic indication of the absorption of microbial toxins generated during a bacterial invasion of the intestinal mucosa. Disorders, hitherto generically grouped as blood diseases—disorders such as splenic anæmia, chlorosis, and the different leukæmias—are now regarded by many clinicians as undoubted intestinal infections, while morbid processes like

cirrhosis of the liver, Banti's disease, and other visceral degenerations, have fallen under the same suspicion. The ultimate solution of these questions must depend on improved methods of research, and on further knowledge of the physiological chemistry of assimilation, but some light may be gained by the clinical study of a concrete instance of intestinal auto-intoxication, such as we find in sprue, and by comparison of its symptoms and processes with those of proved intestinal toxæmias occurring in the lower animals.

Normally, and in health, the prominent facts in intestinal bacteriology are as follows: First, that we have a tube, in the lower half of which, at least, swarms of micro-organisms proliferate in such inconceivable numbers that no term of computation can ever furnish any expression of their quantity; secondly, that though they develop and reproduce in closest contact with the mucosa, continually bathing it in their secretions, neither they nor their toxins, under ordinary circumstances, find opportunity to enter the circulation, the portals of which stand so widely open to legitimate nutriment; and, thirdly, that after death, and in the course of various diseases, and perhaps under some other exceptional conditions, a small proportion of them, or of one variety of them or their toxins, may penetrate the mucosa and gain access to the systemic vessels.

To appreciate the bearing of these facts on the toxæmia of Sprue, it is necessary to determine in what way immunity to hostile micro-organisms or toxins is under ordinary circumstances secured. Is it due to phagocytic protection? Do masses of leucocytes, lying somewhere in the coats and follicles of the intestine, intercept and destroy them? The answer is that there is no evidence that any considerable part of the protection is due to leucocytic activity. In the first place, no actual phagocytosis has, under

normal conditions, been observed, though careful search has been made for it. Further, were protection due to phagocytosis, we would expect to find in the human intestine, instead of disconnected and rudimentary patches, large and continuous masses of lymphoid tissue, such as are to be seen in rabbits and other animals of the same order. As a matter of fact, leucocytes are by no means numerous, in normal conditions, in the walls of the human intestine, while we can scarcely believe that the bacterial life of the lumen is less abundant or virulent than it is in rodents.

It does not, of course, follow that an excess of toxins in the intestine results in toxæmia. Putrefaction is normal, at least in the lower sections of the tube; even in the upper, when the epithelium is intact, it may be very extensive and yet innocuous. But in the latter case, though toxins are not absorbed, that some of the residual products find their way into the systemic circulation is evident from the proportional increase of benzol derivatives in the urine when there is putrefaction. Not only does the blood take up nutriment from the lacteals; it can also without ill-effect receive products which can scarcely be otherwise than deleterious, and at the same time it is able to reject the toxins that induce toxæmia.

The explanation of these facts is to be found, partly, as has been seen, in the condition of the epithelium, but in a far greater degree in the condition of the blood itself. With reference to this aspect of intestinal auto-intoxication an important addition to our knowledge has recently been supplied by Comparative Pathology.

In a report to the Board of Agriculture and Fisheries, Professor Hamilton[7] has shown that a disease of the sheep, formerly known

[7] Hamilton, Professor. "Report to Board of Agriculture and Fisheries on Certain Diseases of the Sheep." 1906. Wyman and Sons.

as louping-ill (now named chorea paralytica), as well as some other affections akin to it, are intestinal auto-intoxications, the former being caused by a specific anaërobic sporing bacillus, which gains entrance to the alimentary canal through the mouth, and which develops in extraordinary numbers in the intestinal mucosa; that, in some respects, the process may be said to be climatic, for during susceptible months the bacillus is able to penetrate the coats of the gut to the peritoneal sac, in the secretion and on the epithelium of which it finds a medium highly favourable for development; that growth there is followed by definite and fatal symptoms of auto-intoxication; that, in unfavourable months, the passage of the bacillus through the intestine is inhibited, owing to its being bacteriolysed by the blood; and that during susceptible months the blood loses this bacteriolytic power. This explanation of the pathogenesis of a known intestinal auto-intoxication is instructive and significant, for it is probable that, in sprue at least, the process is on closely parallel lines.

Conceptions of intestinal toxæmia must therefore be modified, and fatal effects must be ascribed to failure of resistance in the blood, and consequent invasion of the peritoneal cavity by a specific organism. Hamilton has further shown that other bacilli—all of them anaërobes—normally present in the intestine, possess hæmolytic powers of high intensity, and that they become nocuous merely by loss of bacteriolysing power in the blood. It is possible that this is the case in sprue, although, as has been seen, there are other circumstances which strongly favour the view that toxæmia is the result of a specific infection. Destruction of the epithelium of the intestinal wall no doubt allows freer passage to a microbial invasion, but the conclusion is almost irresistible that protection is ultimately secured by the blood itself, and that immunity depends on whether the condition of the plasma is one of receptivity or repulsion to a hostile microbe.

Additional verisimilitude is lent to this theory of invasion by considerations of climate and surroundings. As in armies in the field, in asylums, and under some other circumstances, there is loss of resistance to the infection of dysentery, so it may well be the case that, in sprue, failure to withstand the toxins of a specific micro-organism may be slowly induced through the deterioration of blood plasma by prolonged exposure to localised climatic conditions.

CHAPTER VI.

DIAGNOSIS.

THE diagnosis of Sprue is important chiefly on account of the frequency with which the disease is overlooked. The insidious and protracted character of the symptoms, and their variability in severity and type, enable it in a very large number of instances to successfully elude recognition, and to pass through all the different stages undetermined and practically untreated. An ordinary and typical case of Sprue presents few difficulties; in general, the indications as to the nature of the disorder are obvious, and, in the Tropics at least, it is seldom mistaken; but outside the endemic area, and when characteristic features are modified or suppressed, Sprue, perhaps oftener than any other tropical affection, escapes identification. When the occurrence of Sprue is unanticipated, physicians are insufficiently on the alert as to the possible import of unfamiliar symptoms; and it is also true that the disease, as seen in patients after their return to a cold climate, is more frequently irregular in type than in the countries where it is endemic. When suspicion has been aroused, difficulty is generally at an end.

In the Tropics, local disorders—such as the more chronic and intractable forms of stomatitis, or an unusual type of diarrhœa—occasionally give rise to considerable doubt, although their true nature is seldom long at issue, while graver infections, such as

anchylostomiasis, in most instances readily admit of accurate diagnosis. But in patients seen at home the question is different; for here the danger is that, although the disease is sprue, it may fail to be recognized.

In making a diagnosis, the history is obviously of the first importance. If the patient has had no tropical residence, the assumption that he is suffering from sprue may be definitely put aside; but, on the other hand, if he has been in the Tropics—more particularly in the Eastern Tropics—any form of chronic digestive disturbance or diarrhœa should be regarded with suspicion. His residence may have been of the shortest, and yet sufficient for the contraction of the disease, for authenticated instances are on record in which a sojourn of only a few hours in a port of Cochin China was followed, after return to Europe, by the development of Sprue in a typical form.

In England, Sprue is perhaps oftenest seen in patients in whom the disease has been lurking unsuspected for years. It is usual to find in such instances that the history is somewhat as follows: The patient was formerly resident in the Tropics, where he had suffered from dyspepsia, occasional diarrhœa, lassitude, and intermittent sore mouth. At the time little importance had been attached to those symptoms, and they were thought to be merely incidents of tropical life. After his return home he found that he did not "pick up" as he expected; on the contrary, his health got worse, and he rapidly lost flesh. Possibly, too, he was treated for indigestion and intestinal irritability by large doses of bismuth, and for diarrhœa by opium and astringents; and, not improbably, he underwent a "cure" at Carlsbad or some other spa. He is fortunate if the condition of his tongue did not entail in addition a course of mercury; but, in any case, he is certain to have received vigorous and radical treatment.

Uncomplicated cases of Sprue have, more than once, been treated first as syphilis, and then as mercurial stomatitis; and though such errors scarcely come within the scope of a scientific diagnosis, it is by no means unusual to find Sprue mistaken for malignant disease of the liver, stomach, or intestines. Scurvy and other systemic dyscrasias frequently exhibit mouth lesions which, especially in the earlier stages, may closely resemble those of Sprue; but in such instances, as remedial measures are generally on the same lines, an error in diagnosis, though serious, is of less importance than when drastic treatment by drugs seems to be invited.

The principal diseases with which Sprue is likely to be confounded are: stomatitis, white flux, hill diarrhœa, atrophic degenerations of the stomach and intestines, anchylostomiasis, pancreatic disease, and progressive pernicious anæmia.

STOMATITIS.—In the Tropics, inflammation of the mouth and pharynx is even more common than in Europe, but the types which it assumes are much the same. Usually, it is seen as diffuse, aphthous, or vesicular stomatitis, and, in children, as thrush; but the graver forms of fœtid ulcerative inflammation and cancrum oris are by no means rare; pharyngitis sicca is frequent, and pyorrhœa alveolaris (Rigg's disease) very prevalent. Not infrequently a disordered state of the alimentary canal accompanies inflammation of the mouth, and manifests itself by concomitant diarrhœa; and in such cases ordinary stomatitis may be difficult of distinction from the initial phases of Sprue.

In the oral irritation which results from excessive smoking, and from alcoholism, and which is seen in many septic conditions, especially in the earlier stages of Rigg's disease, the dorsum of the tongue is raw, and the fungiform papillæ are red, swollen and angry; but the characteristic vesicular eruption on the tip and

edges of the tongue is unusual in any affection except sprue. The initial stages of the disorder are, however, so deceptive that there may be nothing on which to base a diagnosis from merely local conditions beyond the results of treatment. In the absence of dietetic restrictions, Sprue lesions are little if at all influenced by antiseptics or by the stoppage of alcohol and tobacco, while in stomatitis due to the latter irritants the withdrawal of the exciting cause is quickly followed by improvement. Although seldom seen until diagnosis is of comparatively little importance, the thrush, which in the Tropics forms on the lips and buccal mucous membrane during the later stages of many cachexial diseases, has much in common with the lesions of sprue. Occasionally, however, it appears before the patient seems to be very ill, and it is then generally accompanied by colourless diarrhœa. Although the conditions differ widely, the nature of such cases may be doubtful, for the desquamation, superficial ulceration, and fissures are very similar, while the general symptoms are often practically the same.

WHITE FLUX OR DIARRHŒA ALBA is common in the Tropics, as in other parts of the world, and occasionally it occurs in epidemic form. The principal features of the disorder are intestinal pain with diarrhœa, the dejecta being devoid of bile, and, like those of sprue, clay-coloured, pultaceous and frothy. There is generally nausea and sickness, severe headache, and, rarely, icterus. As a rule there is no fever, although the subnormal temperature and bradycardia, characteristic of obstructive jaundice, are seldom observed. Occasionally the symptoms are somewhat acute, and the exhaustion consequent on vomiting and purging may give rise to anxiety, but white flux is, in general, a trivial ailment, and it yields readily to treatment. This feature, in addition to the absence of mouth sores, should prevent its being confused with sprue. The pathogenic origin of white flux is

unknown, but the absence of bile from the dejecta having been definitely proved, the condition would appear to be that of gastro-intestinal catarrhal congestion, with occlusion of the common bile duct.

Another form of white flux, indistinguishable from the disorder known at home as Diarrhœa chylosa, or Gee's cœliac diarrhœa, is common in the Eastern Tropics, and still more closely simulates sprue. Though usually seen as a disease of children, adults are often affected. It is characterized by frequent loose stools which are pale, bulky, frothy and offensive; vomiting is unusual, and jaundice is never seen. After some time, progressive wasting, pallor and toxæmia set in, and the course of the disease may then be protracted and severe. The type, however, is generally less malignant than that of sprue, and in most instances the symptoms yield to small doses of mercuric chloride. There are, also, no distinctive mouth lesions, although Gee's diarrhœa is often associated with thrush. Oidium albicans may be found, but its absence is inconclusive.

HILL DIARRHŒA, with which these forms of white flux are intimately associated, is described in the next chapter.

ATROPHY OF THE STOMACH, the result of chronic catarrh, is also common in the Tropics. It is generally seen in Europeans who have had a lengthened residence and a history of alcoholism. Not infrequently, in such cases, the constipation usually characteristic of gastric atrophy at home is replaced by diarrhœa, which resembles that of sprue, and there may then be considerable difficulty in making a diagnosis. Both in the interstitial variety of this degeneration, where the walls of the stomach are sclerosed and thickened at the expense of its cavity, and in the type marked by extreme dilatation of the viscus, the dejecta may be copious, loose, pale, and frothy. In gastric atrophy vomiting is a more

prominent symptom than it is in sprue, and the mouth is seldom affected; but the gastric facies and a definite degree of toxæmia are usual. The diagnosis is important, and a careful attempt should always be made to determine the size and actual condition of the stomach, for lavage, in sprue, might do serious harm. Mouth symptoms, unless very characteristic, afford little assistance.

In a fatal case in my own experience, which had been diagnosed and treated as sprue, the physical signs were uncertain, intermittent stomatitis and vomiting being the most prominent symptoms. There was also persistent, though uncharacteristic, diarrhœa, and some degree of toxæmia, but the only evidence of disease found after death was a sclerosed and contracted stomach. The history was one of long continued alcoholism.

ATROPHIC ATONY OF THE COLON, though uncommon in the Tropics, is also frequently attended by colourless dejecta, diarrhœa, toxæmia, and failure of nutrition. Mouth lesions are rare. The history and physical signs generally afford some assistance, but when atrophy of the colon assumes a sprue-like form in a tropical case, it is impossible to be confident as to the nature of the condition. Fortunately, however, unless surgical intervention is necessary, a correct diagnosis, as between the two diseases, is of less importance than in some other cases, for their treatment is, practically, the same.

ANCHYLOSTOMIASIS is prevalent in all the countries where sprue is endemic, and reference to the appended table will show that the clinical similarity between the two conditions is often very remarkable. Confusion is almost certain to arise unless anchylostome infection is excluded by systematic search for ova, and, in every instance, the dejecta should be carefully examined by the microscope. Repeated examination is necessary to establish the diagnosis, for symptoms of anchylostomiasis may be absent,

although adult parasites are numerous. Infection, too, is only presumably negatived by failure to find eggs. In the Tropics, not more than 20 per cent. of those who harbour anchylostomes show any systemic evidence of the infection; but, on the other hand, severe and persistent toxæmia may result from the presence of only two or three worms. Again, it must be remembered that the discovery of ova does not necessarily debar the possibility of Sprue, for, not infrequently, that disorder is complicated by infections of parasitic entozoa, and it is especially prone to combination with anchylostomes.

The diagnosis is important, for if sprue be mistaken for anchylostomiasis, and large doses of thymol be given to a patient in an advanced stage of the disease, the result may be disastrous. Though not without their own risks, the introduction of Beta-naphthol and eucalyptus as remedies has, however, somewhat mitigated that danger. Scarcely less serious, on the other hand, is the converse error, for a diet such as is usually prescribed in sprue favours, in a surprising manner, the development of anchylostomiasis.

As an aid to diagnosis, the occurrence of eosinophilia, both relative and absolute, in anchylostomiasis is second in importance only to the verification of the infection by the discovery of ova, and blood examination should always be undertaken to determine whether that condition is present.

Although AFFECTIONS OF THE PANCREAS are, as at home, somewhat unusual in the Tropics, chronic disease of that gland should also be borne in mind as a possible source of error, for whether the changes are fibrotic, cystic, malignant, or merely inflammatory, the train of symptoms by which they are characterized invariably bears a close resemblance to the usual course of Sprue. In the great majority of cases, Pancreatic disease is

seen only after middle life; it is insidious and extremely chronic; there is alternate exacerbation and improvement, and there are frequent and severe digestive disturbances, with clay-coloured and fermenting dejecta. Not infrequently, too, there is septic stomatitis. In one case in which the latter symptom had persisted for six years, the patient was thought to be suffering from sprue, but the only evidence of disease disclosed by *post-mortem* examination was a small carcinomatous growth in the head of the pancreas. No tumour had been perceptible during life, and the liver was normal in size. In such instances, the diagnosis must always be one of considerable doubt, but assistance may be derived from the history of the case, from the character of the excreta, the absence of bilious diarrhœa, the size of the liver, and from the fact that in pancreatic disease the condition is one of general failure of nutrition rather than of definite toxæmia.

Toxæmic sprue, especially when seen in England, is liable to be mistaken for PROGRESSIVE PERNICIOUS ANÆMIA. Confusion between two such well-marked clinical conditions might be thought improbable, but, as a matter of fact, the mistake is one that is by no means unlikely to occur. In their symptoms, progress, and nature there is much affinity between the two disorders; both are toxæmias of intestinal origin, in both hæmolysis is severe, and in both cachexia is irregular and intermittent. In many cases of pernicious anæmia there is septic inflammation of the mouth, throat, and stomach, and occasionally there is diarrhœa. It is noteworthy, too, that treatment has recently yielded significant indications as to the nature of this affinity. Hollis and Ditman,[1] for instance, report two cases of undoubted pernicious anæmia, in one of which, after daily high irrigation of the colon, the count

[1] Hollis and Ditman: *Medical Record*, February, 2, 1907.

of red corpuscles increased from 900,000 to 3,800,000 per c.mm., and in the other from 1,500,000 to 5,000,000. Further corroboration of the intestinal origin of the disease and of its essential similarity to Sprue has been adduced by SAHLI in his work on the desmoid reaction.

The diagnosis is of much importance, for arsenic in any form is an inadmissible remedy in Sprue, and its administration may do serious harm. The decision practically turns upon the condition of the blood. Even in advanced sprue, it does not show the profound alterations of pernicious anæmia: the reduction of the red corpuscles is moderate, to two or three millions per cubic millimetre; there is no poikilocytosis, and, though normoblasts are frequently seen, there are no megaloblasts, and no nuclear mitosis. The type of wasting is also of considerable diagnostic significance; "fat" cachexia is never seen in Sprue; emaciation, though gradual, is progressive, and loss of flesh is more marked than in pernicious anæmia.

It must not, however, be forgotten that the distribution of the latter disease is world-wide, and that it is common in countries where Sprue is endemic. It thus happens that in the Tropics pernicious anæmia is sometimes mistaken for Sprue, but in such a case the consequences entailed by an error in diagnosis are less serious than when the mistake is in the other direction.

A table embodying the principal diagnostic characteristics of progressive pernicious anæmia, anchylostomiasis and Sprue, is appended.

CHAPTER VII.

HILL DIARRHŒA.

HILL DIARRHŒA is a disorder of the digestive system, which, although not confined to high altitudes, usually affects residents of the more elevated districts of the Eastern Tropics, and is especially prevalent in some of the Sanatoria and Hill stations of India. In typical instances, it assumes the form of an acholic gastro-intestinal catarrh, the symptoms being nausea, abdominal pain, and diarrhœa. The evacuations are most frequent in the early morning, and are loose, copious, frothy and colourless. In its nature, Hill diarrhœa is less malignant than sprue, and as a rule it is readily amenable to treatment; but occasionally it is complicated by choleriform seizures, and, not infrequently, it passes into a chronic and somewhat intractable condition. Though all classes and races are subject to this disorder, Europeans are principally affected, visitors who have recently arrived from hot, low-lying districts being particularly liable to attack.

NOMENCLATURE.—The title is by no means a good one, for the disorder is not peculiar to Hill stations. Although known by different designations, symptomatically indistinguishable affections are of frequent occurrence in the plains of India, and are widely distributed, both in low and high countries, throughout the world. Sir J. Fayrer[1] says: "The Hill diarrhœa and the white flux of

[1] Fayrer, "Tropical Diseases and Chronic Diarrhœa." London: Churchill, 1881.

other parts of India are only modifications of the same disease, and in their pathology and symptoms so much alike, that I regard them as identical." Lieut.-Colonel Crombie,[1] of the Indian Medical Service, who had a very large experience of the disorder, goes farther, and advocates a change of name. He contends that it is a mistake to make use of a title which is a pathological misnomer, and says that although Hill diarrhœa is of everyday occurrence at all Hill stations, and is exceptionally prevalent in Simla, it is not confined to high altitudes in India or elsewhere, but is prevalent in Europe, South Africa, and many other parts of the world.

A change of name, however, would seem to be inexpedient. In view of the general acceptation of the term "Hill diarrhœa," it is inadvisable to alter, even though not strictly accurate, the designation by which the affection has come to be known, and by which it is familiar to most residents in the Tropics.

SYMPTOMS.—The usual course of a moderately severe attack of Hill diarrhœa in the Tropics is somewhat as follows: Soon after arrival at a Hill station—in most cases, immediately after—a visitor is awakened during the night by sharp abdominal pain. The seizure is invariably coincident or subsequent to a chill; it often comes on in the early morning before sunrise, and is sometimes obviously caused by exposure to night air. As a rule, there is a rigor, and the temperature rises to about 102°. Nausea, headache, and sickness are intense; the food that was eaten the previous evening is returned undigested, and if the patient attempts to take anything—even a small quantity of iced milk or soda water—it is immediately rejected. With the onset of the pain, there are frequent calls to stool—generally eight to ten in the course of the morning. The

[1] Crombie, *Indian Medical Gazette*, 1892, p. 129.

intestinal discharges, at first bilious, acrid, and lienteric, soon change in colour and become colourless, loose, and frothy; in most cases, the third or fourth motion is quite white. Crombie, not inaptly, compares the dejecta of Hill diarrhœa to whitewash which has been well shaken. There is no jaundice. Evacuation brings relief; with the purging, the pain and discomfort disappear; before noon, the sickness passes off, the diarrhœa stops, and the patient feels comparatively well. But he is by no means over his trouble; indigestion is continuous and acute, and although he feels hungry, he can take nothing but sips of milk or soup; if he eats solid food, nausea, griping, and diarrhœa immediately recur.

These symptoms are apt to be repeated the following morning, and to continue, with more or less severity, for some days, or it may be, if left untreated or neglected, for weeks; they are aggravated by cold, and especially by the wet, moisture-laden winds which are usual in the Hills during the monsoons. In the great majority of instances, however, the tendency of Hill diarrhœa is benign; there is no constitutional effect or deterioration, and the symptoms yield readily to suitable treatment. As the patient acquires acclimatization in the Hills, liability to attack decreases, seizures subside spontaneously, and recurrence is less frequent.

Like Sprue, Hill diarrhœa not only varies in intensity of severity, but it also assumes many different phases, or types. Occasionally, the dyspeptic and gastric symptoms are accentuated, and there may then be little abdominal pain or diarrhœa. In such cases indigestion is acute, and nausea and vomiting exceptionally urgent and severe. More often, however, diarrhœa is the predominant feature; it may be violent, but, as a rule, it is slight and, beyond the passage of two or three loose and colourless evacuations in the early morning, there may be little further evidence of illness or

disturbance. It is indeed a common incident of residence at an Indian Hill station to find that many residents and visitors are confined during the morning to their rooms, but that, later in the day, they are able to walk, ride, or play tennis without fatigue or discomfort.

On the other hand, the type assumed by Hill diarrhœa is sometimes so grave as to be the cause of serious anxiety. Although, fortunately, such instances are comparatively rare, the seizure may be of choleraic intensity; and an illness, beginning apparently as simple Hill diarrhœa, may rapidly develop symptoms of extensive and acute enteritis, and terminate unexpectedly in exhaustion, collapse and death. Probably, in all such cases, Hill diarrhœa is complicated by cholera or some other specific infection; but in dealing with what appears to be an ordinary attack, the possibility of an untoward event should always be borne in mind.

A more common termination is that the disorder gradually passes into a chronic condition. In these instances, though the acute symptoms subside, dyspepsia and gastro-intestinal irritation persist for an indefinite period. There are three or four calls to stool, with much flatulence and griping, in the early morning. The dejecta are loose, copious, colourless, and generally very offensive; in most cases they contain a good deal of mucin, and, sometimes, unaltered bile; occasionally they are tinged with blood. The patient is able to go about and to attend to business; as a rule he experiences little pain, but indigestion is constant, and he loses flesh. There are no mouth sores, and, though emaciation may be very considerable, there is no toxæmia. The condition is, however, somewhat serious; there is always danger of the supervention of acute choleriform seizures; on the other hand the disorder may become established as chronic Hill diarrhœa and continue for

years. Treatment that would have resulted in a speedy cure, had it been undertaken at an earlier period, may be altogether inefficacious; and although the disease generally yields, even in these later stages, to a complete change of climate and diet, death may occur in the meantime from progressive emaciation and lack of nutrition.

THE RELATION OF SPRUE TO HILL DIARRHŒA AND WHITE FLUX.—By general consent, Sprue is now regarded as essentially distinct from Hill diarrhœa and every other variety of white flux. In this view all later writers agree; and although considerable uncertainty still exists as to the relations which the various disorders characterised by acholic diarrhœa bear to each other, there can be no doubt that they are all widely separated from Sprue. Still, although between Hill diarrhœa and conditions allied to it on the one hand, and sprue on the other, there is no pathological or ætiological connection, the similarity of chronic cases of the former group to sprue is, in some instances, very striking, and it may, indeed, be very difficult to differentiate them. The following diagnostic points should be borne in mind: Hill diarrhœa appears immediately after the chill by which it is originated; the slow, insidious, prodromal symptoms indicative of sprue are never seen; further, it presents none of the characteristics of a specific infection; there are not, nor have there been at any antecedent period, definite mouth lesions; there is no diminution in the area of liver dulness, and it is never attended by marked toxæmia. Of these various indications, the absence of mouth lesions is perhaps the most important. Lt.-Col. DUNCAN, whose experience of the disorder in India was unusually extensive, says:[3] "I have never seen in any cases of Hill diarrhœa the mouth symptoms

[3] Duncan, *British Medical Journal*, 1905, page 1283.

of Sprue; nor have I ever observed the diminution in liver dulness." Hill diarrhœa is further distinguished from sprue by the absence of preliminary bilious diarrhœa, by the character of the dejecta, and by the lack of any notable tendency to undulation and relapse, all of which are prominent features both in favourable and fatal instances of the latter disease.

The association—and, it must be added, the confusion—between Hill diarrhœa and sprue are of long standing, and the literature bearing on the subject, though somewhat fragmentary and scattered is now considerable. The original accounts of HILLARY and GRANT, however, still remain among the most notable contributions to our knowledge, and are worthy of careful study. Both authors were keen observers and interpreters, and their graphic clinical descriptions teem with suggestive information as to exotic diseases generally, and especially to those intestinal affections which are peculiar to the Tropics. It is, indeed, not a little curious that twice, at an interval of almost a century in time, and of half the world in space, different writers, the latter of whom apparently knew nothing of the former's work, should have called attention to a disorder the symptoms and morbid appearances of which were indistinguishable from those of sprue. In both instances, in the places where they stated it to be endemic, the disease is now unknown, or if it exists at all, is of very rare occurrence; but the descriptions are so full, so accurate, and altogether so convincing, that, if the disorder of which they wrote was not genuine sprue, it can only be said that no classification of disease on a clinical basis would appear to be possible.

The first of these statements was that of HILLARY, in the West Indies; to this reference has already been made, and extracts from it have been quoted in the chapter on the history and literature of sprue; the other, which appeared in 1854, is by Surgeon ALEXANDER

GRANT, of the Bengal Army. The title of the paper was "Hill Diarrhœa and Dysentery, with brief notices of some of the Himalayan Sanatoria."[4] Grant's contribution attracted considerable attention at the time it was published, but it seems to have become difficult of access to later writers, for although most of them were aware of its existence, statements as to his writings were seldom, if ever, verified by actual reference to the paper. Errors thus introduced were copied by subsequent authors from each other, and endless misapprehension and confusion, both as to the nature of Hill diarrhœa and as to the relation it bears to sprue, have since arisen.

The subject is of sufficient interest and importance to warrant the citation of GRANT'S somewhat discursive narrative at length. It is, indeed, impossible to convey a correct apprehension of his views unless they are stated, as far as possible, in his own words. He said that at Simla—an elevation of 6,500 to 8,000 feet—at Dagshai—24 miles from Simla, and 6,000 feet high—at Subathoo, —22 miles from Simla, and 4,000 feet high—and at Kasauli—32 miles from Simla, and 6,400 feet high, an inveterate form of bowel complaint was endemic; that it caused a high rate of mortality among the English troops, and that it was a source of serious inefficiency and loss to the regiments which had been stationed at these places for years after they returned to the plains. GRANT insisted that the disorder was confined to those four stations, and that it was unknown at Mussoorie, Naini Tal, Murree, Darjiling, Mahableshwar, and in the Neilgherries. His general description is as follows :—

"The attack is not generally preceded by nausea or griping, but there are dyspeptic symptoms, loss of relish for food, much

[4] A. Grant, F.R.C.S., "Indian Annals of Medical Science," 1854, Vol. I.

flatulence, and distension of stomach. . . . The calls to stool are urgent and frequent, the dejecta are very fluid, and contain air bubbles. . . . they vary in number from four or five to a dozen in the course of the twenty-four hours. The patient views the disease as trivial. . . . he eats and drinks as may be his wont, and in this way he may go on for months, until he begins to droop, to look ill, and to lose flesh to a degree that attracts notice. . . .

"There is great natural susceptibiltty to attacks among persons of strumous habit, in whom the disease shows itself in an intractable form, even resisting early and prompt treatment and change of climate. . . . the temperate suffer equally with the intemperate, but the mortality among these last is much higher.

"In all cases there is arrest of the biliary secretion, and it may be pronounced that the disordered function of the liver is an essential characteristic of the disease; there is also simultaneous derangement of the functions of the skin, which is harsh and dry. . . . it is difficult to excite perspiration; the face is pale, and, in the advanced stages, wan and sallow, or of a pomegranate colour.

"The depraved and diminished secretion of bile is indicated by the peculiar and almost constant character of stools, which are of a pale drab or muddy gray colour, frothy and feculent; in the early stage often white and very loose, afterwards becoming pultaceous and yeasty, of the character termed lienteric. I have never noticed them dark-coloured, and they rarely contain mucus or serum, the products of inflammatory action; they are passed between daylight and breakfast-time, and again as evening approaches; their odour is peculiar and unnatural, but not offensive.

"By far the most distressing symptom is the tumefaction and flatulent distension of the abdomen; this is always worse towards evening, and is only relieved by copious evacuations. . . .

"The state of the tongue and mouth is remarkable and characteristic. There is in a vast majority of cases an aphthous and congested condition of the lining membrane, and the irritation often extends to the œsophagus; there are also superficial ulcerations and deep indentations round the margin of the tongue, and the gums are congested and bleed freely. Or the tongue may present a white appearance, with streaks or chaps, and mere redness about the edges; in the latter stages it becomes shining, raw, and fissured, or dry and rough, especially in the centre; there is at length difficulty in swallowing, and as death approaches, the power of utterance fails. . . . Progressive emaciation is another pervading characteristic of the disease, and is often our first warning of danger. It makes us justly suspicious of enlargement of the mesenteric glands, or of organic lesions of the mucous membrane and some of its follicles, and wherever it advances we may confidently recommend a thorough change of climate as absolutely demanded. As the disease progresses, we notice that assimilation and nutrition, which in the early stage seemed only perverted, become, at length, nearly destroyed. The mind becomes weak and the temper fretful, the emaciation is extreme, and organic and vital exhaustion is marked by œdema of the legs and dropsy of the abdomen. But even these last symptoms of constitutional decay do not indicate a state altogether hopeless. A few of such cases rally, and ultimately recover by means of great care and total change of climate, although the subjects of them will suffer through life from an enfeebled condition of the alimentary canal. "The last of the symptoms to be noticed is that of the appetite, which is often not much impaired; on the contrary, it may be keen, with great craving for animal food, and for many things which are most injurious; this capriciousness often continues to the last, and is a source of much vexation and anxiety to the physician.

"Relapse is common and easily induced; an error of diet, a change in the weather, as from dry to wet, will bring back and aggravate all the symptoms. It is almost needless to add that ardent spirits act as a poison, and often prove poisonous to soldiers who can procure them. But the tendency to relapse will continue long after their return to the plains; the men. . . . have a sallow, earthy, and sunken complexion, pale lips, a dull lack-lustre eye, a tongue morbidly red about the edges, feeble digestion, imperfect nutrition, and a feeble or slouching gait. They are, in fact, below the standard of health, the stools are not perhaps numerous, but pultaceous and feculent, yet wanting in the natural bilious colour, and too bulky in proportion to the food. With increasing bodily weakness, we observe great irritability of temper and mental despondency, languid circulation, listlessness, cold feet, and such like indications of the great reduction in organic and vital power. In the diarrhœa which proved so fatal in China, there was noticed a similar pervading cachectic condition, with increasing attenuation and debility; and when recovery did take place, such inroads were made upon the constitution that the officer remained a valetudinarian for life, while the poor soldier soon perished from some other disease, to which his broken health made him doubly liable."

In his remarks on pathology, GRANT says: "The bowels, like the body, are pale, blanched, and anæmic, or the coats of the intestines are strikingly atrophied and, in places, diaphanous. This applies peculiarly to the small intestines, while there are leaden spots in the colon, which is easily lacerated. In other cases, the mesenteric glands and the mucous follicles of the intestines are enlarged, and the calibre of the gut is narrowed in places, and its mucous membrane softened, pulpy and hypertrophied, with serous exudation under it, or simply thickened and in a red granular

state. . . . In general the liver is small, pale and friable, especially in the anæmic cases. . . . The spleen is generally small and not diseased, . . . the heart small and flabby, and its walls attenuated."

"When early treated, the disease is absolutely and easily curable. But, on the contrary, when neglected or concealed we see a form of disease very different in the conditions of its development and fatality, and even when, on early application, it is relieved, there is no perfect cure, the men long remaining feeble, and in a state of imperfect efficiency."

GRANT regarded the disease as a manifestation of scurvy, and considered that the mouth lesions clearly indicated this taint: "Of the essential nature of land scurvy," he says, "we are as yet ignorant, and it is known only by its effects; it is by no means always dependent on the want of vegetables. . . . In the hills I suspect it is much more common than is generally supposed; many of the cases I have noted were marked only by a cachectic state of body, by soreness of the tongue and œsophagus, or by pains in the thighs and long bones."

He further states that this form of diarrhœa had been previously described by a Mr. WILSON in a paper in "Medical Notes"—an article which I have been unable to trace—but which, apparently, dealt with the health of the crews of British warships on the China Station. The repeated allusions to China are, indeed, a notable feature of GRANT'S description. He himself accompanied the expeditionary force which went from India to that country in 1841, and he saw much active service in the first China War. He was afterwards stationed for three years in Chusan, during the occupation of that island by the British troops. While there, he observed many similar cases, and he himself had the misfortune to contract the disorder, "which was ultimately

cured, but which left," he says, "a distressingly debilitated state of the digestive organs."

It is possible that GRANT had something of a tendency—not uncommon in medical men of our own time—to assimilate the symptoms of his patients to those of which he had personal experience, and it may be suspected that he was, in consequence, looking at the ordinary Hill diarrhœa of India through Chinese spectacles, but there is much intrinsic evidence in his narrative to show that this was not the case. GRANT'S observations are everywhere critical and deductive, and his descriptions lucid and convincing. He states emphatically and clearly that he saw three types of the disorder, one, a comparatively trivial affection, which was induced by a chill, and which was, doubtless, Hill diarrhœa; another, presenting the characters of true dysentery—which he describes as "Hill Dysentery"; and a third, or marasmic type, with mouth sores, the description of which has been quoted, and which was, evidently, Sprue. It is obvious that this marasmic or toxæmic form differs from the ordinary Hill diarrhœa of India; and it is more than probable that GRANT actually saw, and included in his description, not three different types of one disorder, but three entirely different disorders: viz., Hill diarrhœa proper, which has always been prevalent at Simla, dysentery, and sprue.

As, at that time, medical officers were closely identified with the corps to which they were attached, accompanying them on active service, and returning with them to their respective bases, it may be conjectured that the affected regiments had been with GRANT in China, and that the sprue from which they suffered had been contracted there. So far as clinical characteristics are concerned, there is nothing improbable about such an hypothesis; on the contrary, the circumstance that the disease remained latent for so long, and declared itself after the troops were sent to the

Hills, affecting men of particular regiments, and appearing only at particular stations, is strong presumptive evidence that it was indeed genuine Sprue. But, unfortunately for this theory of origin of the outbreak, I have ascertained from information courteously supplied by the War Office, that the regiments which were most seriously affected—the 29th Foot and the 60th Rifles—did not serve in the China War; and although it is possible that drafts which had returned from China were incorporated with them in order to obtain the advantage of a change to the Hills, the men who suffered from the disease do not appear to have been stationed at Chusan with GRANT, or to have been engaged in the operations on the mainland. The 29th Foot went to India from England in 1842, and were described by GRANT, when they arrived at Kasauli in 1846, after active service with the Army of the Sutlej, as "having been in a sickly condition with a taint of scurvy for years." The 60th Rifles went to India from England in 1845, and they were stationed at Kasauli and Subathoo in 1850-51. There was, however, during this time an active interchange of troops between India and China, and it is not improbable that parties from these regiments were sent on special service to China, and that returning units from other regiments joined them on their going to the Hills; but beyond this conjectural explanation, there is no record of direct contact with the area of endemicity.

GRANT'S paper was the first systematic description of Hill diarrhœa in India, and in calling attention to the prevalence of the disorder at stations to which troops were sent to recruit their health, he did excellent service. In the cantonments, sanitary and other hygienic reforms were at once instituted, and though the precautions which were taken did not eradicate the disease, its prevalence and severity were considerably abated.

Of the MORBID ANATOMY AND PATHOLOGY of Hill diarrhœa

little is known. Autopsies have been reported only in a few instances, and it is uncertain whether these were uncomplicated cases of the disease. The condition would seem, however, to begin invariably in general congestion of the mucosa of the stomach and intestines. There is no preliminary invasion of the sub-mucosa. In chronic cases, the congestion is followed by proliferation of lymphoid and fibrous tissue, and, as in sprue, granular projections of epithelium and subepithelial connective tissue not infrequently protrude from the surface of the mucous membrane into the lumen of the bowel. The secretory glands are catarrhal and congested; but there is no desquamation or extensive degeneration of epithelium. The mucosa is described as being often thick and boggy, and both in the ileum and colon the surface is generally covered by a thick, adhesive coat of viscid mucus. Except in dysenteric cases, there is no ulceration.

The ÆTIOLOGY of Hill diarrhœa is even more unsatisfactory. Many views have been advanced as to the nature of the condition, but congestion of the intestinal mucosa, resulting from sudden contraction of the external circulation, seems to offer the best explanation of the origin of the symptoms. It is argued that the absence of jaundice indicates that there is no resultant obstruction of the common bile duct; that, therefore, Hill diarrhœa cannot be merely a congestion of the intestinal mucosa, and that there must be some further factor in its production. Probably, the secretion of bile is materially influenced by the same cause which originates the intestinal congestion, the condition being one of arrest rather than of obstruction, and it is likely that bile pigments are not secreted in sufficient quantity to produce icteric symptoms. It is difficult, however, to reconcile the view that Hill diarrhœa originates solely in simple congestive chill with the symptoms and morbid anatomy of the chronic forms of the disorder. In such

cases there is obvious persistence of irritation; and the tissue proliferation which takes place in the intestine would appear to indicate a specific pathogenic origin rather than a systemic reaction to cold.

A theory that Hill diarrhœa may be due to the presence of mica in drinking water, formerly advanced by DYSON, has recently been revived and supported by Lt.-Col. DUNCAN. The geological formation on which many Hill stations are built is laterite—a red earth directly derived from the disintegration of granite rocks. In this substance scales of mica are abundant, and, after heavy rain, they, with other impurities, are washed down the steep slopes into the water sources. Streams and wells become turbid and discoloured by the red mud which is thus poured into them, and, even with the aid of settling tanks and filtration, it is frequently impossible in the Hills to obtain clear water for considerable periods. At such times, and especially during the first rains after dry weather, diarrhœa and dysentery are prevalent, and are obviously due to irritation caused by the suspended matter. In the sediment, and in suspension, mica may often be seen, but beyond this, there is no evidence that it is the particular irritant which originates the symptoms, and it is equally probable that diarrhœa is set up by the grit and *débris* of decomposed vegetation which are also present in large quantity. Further, the diarrhœa caused by these impurities is not Hill diarrhœa. It is an irritative purgation, and the dejecta are characteristic of intestinal irritation, that is to say, they contain large quantities of mucus, bile, and, occasionally, blood. There is no connection between these attacks and the specific disorder, Hill diarrhœa, and it is equally difficult to believe that suspended mica stands in a definite causal relation to any form of acholic flux. It may also be noted that one of the principal grounds on which DUNCAN based his opinion was that

at Darjiling, where mica is often seen in the water, Hill diarrhœa is exceptionally prevalent. That may now be true, although GRANT, many years before, selected Darjiling for remark as being unusually free from bowel affections of any kind.

Fæcal contamination of water or food has also been suggested as a possible cause. It is true that conservancy at most Hill stations receives inadequate attention, and that epidemic outbreaks of acute diarrhœa, due to the difficulty of providing sufficient and satisfactory accommodation for the visitors and the numerous native servants who accompany them to the Hills, occur, with routine regularity, during the season at many of the most favoured resorts. These cases, again, are instances of septic enteritis, and have no relation to true Hill diarrhœa. Heavy rainfall on steep declivities everywhere tends to contaminate the springs and watercourses, and, in the Indian hills, the combination of these conditions with overcrowding is a permanent source of serious danger. Sewage pollution in itself, however, is insufficient to account for the characteristic phenomena of Hill diarrhœa.

The fact remains that in the Tropics, the intestinal mucosa is particularly apt to be affected by a chill. Exposure to cold, which in temperate climates would probably be followed by inflammation of the bronchial mucosa, or of the alveoli of the lung, is in hot countries almost invariably reflected as congestion of the intestinal mucous membrane. At tropical Hill stations, the liability of the alimentary canal to such chills is specially marked, and in sudden changes of temperature the majority of cases of Hill diarrhœa doubtless originate.

The treatment of Hill diarrhœa will be considered in a subsequent chapter.

CHAPTER VIII.

The Treatment of Sprue—General Principles.

From our knowledge of the course and general characteristics of the disease, it might reasonably be anticipated that the treatment of Sprue would in every instance prove to be difficult, protracted, and unsatisfactory. That is, however, by no means the case. As a rule, although cure is seldom rapid or complete, sprue is not an intractable affection. With certain very definite limitations, and in comparison with other chronic progressive disorders, it is, on the contrary, exceptionally amenable to treatment. The timely adoption of appropriate measures is almost invariably followed by surprising improvement, and, not infrequently, permanent health is restored to the patient. On the other hand, it is equally true that inability or neglect to carry out the necessary treatment results in chronic invalidism, which only too frequently terminates fatally.

In the treatment of all types and stages of the disease, diet is of pre-eminent importance, and is the one factor which is essential to success. In many cases, indeed in most, no other measures may be necessary beyond the considered administration of food, suitable in quantity and quality, and varied, if need be, from day to day to meet inevitable changes in the receptivity and assimilative power of the patient. The treatment is, therefore, primarily and principally dietetic, and, though this may be carried out in various ways, it is always based on certain clearly defined principles. In practice it is usual to adopt one of several dietetic methods, which collo-

quially are known as "cures"; thus, we speak of the milk cure, the meat cure, the fruit cure, &c., and these terms, though inaccurate and somewhat irregular, are convenient in that they are familiar and well understood. Three conditions are, however, essential to the success of any method of treatment; they are that it be undertaken at a comparatively early stage of the disease; that it be regulated in accordance with changes in the condition of each individual patient; and that it be persistently continued in face of a possible succession of relapses for some months after the last active symptom of illness. Every physician has his own favourite method, but that these therapeutic postulates should be fulfilled is of more importance than that any particular diet should be selected. The problem of treatment is, essentially, one of nutrition, and needless to say, in view of the diseased condition of the alimentary mucosa, it is full of difficulty; but in the great majority of cases it can be satisfactorily solved.

Again, though remedial measures necessarily vary with the race, the age, and the circumstances of the patient, with the way in which he reacts to their influence, with the climatic and hygienic conditions in which he may have to live, and, with the stage of the disorder at which he comes under the physician's care, the essential principles of treatment are in all cases the same. Briefly, they may be summarised as the adoption of a definite and rigid dietetic regimen, with attention to obvious climatic and general indications. If the morbid process is to be arrested, it is imperative to supply the patient with food which, while containing sufficient nourishment for the maintenance of the vital process, shall afford the maximum amount of rest to the digestive apparatus, and the residual products of which shall, as far as possible, be an unfavourable medium for bacterial growth. So generally is this true, and so widely have dietetic measures—as opposed to drugs—been adopted, that the

treatment of sprue has become almost empirical; but it is, nevertheless, rational and practical, and it has been abundantly justified by results. Even in the not inconsiderable number of instances in which, without particular care or treatment, the disease becomes latent before the period of toxæmia is reached, and in which serious symptoms never develop, the unconscious selection of suitable nourishment would seem to be the basis of the apparent cure. It is probable, too, that many tropical residents avoid the actual manifestations of sprue only by continuous care and attention to the quantity and quality of their food, and although excess is by no means essential to the development of the disease, it is certain that even occasional intemperance in eating or drinking may change the type from that of a quiescent, and perhaps unsuspected infection, into an inveterate and malignant form of organic mischief.

In the great majority of instances, and at all stages of the disease, the indications for the initial treatment of Sprue are best met by placing the patient on a diet consisting solely of fresh cow's milk. The experience of most physicians who are familiar with the disorder is that the administration of milk in carefully regulated quantities, to the exclusion of other food, should, almost invariably, be the first of all remedial measures. When fresh milk is obtainable, this procedure is now an almost universal rule of practice, and on this treatment, in the absence of serious complications, and, provided that the disease has not yet reached the more advanced stages, 85 per cent. of all cases do well.

But, although the essential importance of a milk diet is sufficiently accepted, and although such a treatment can be satisfactorily carried out in Europe, the success of the method obviously depends on the quality of the milk at the disposal of the patient. In the Tropics, the nutritive value of milk is by no means constant.

In a few places, where dairy farms have been established under European supervision, milk of excellent quality may be obtained, but, as a rule, tropical milk is unreliable. Often it is impure; even if no water has been added, there is generally a deficiency of butter fat, and of other nutritious constituents, and in hot climates physicians will seldom allow it to form the sole diet of an invalid. Not infrequently, fresh milk is altogether unprocurable, and substitutes, admittedly inferior, have to be found. Treatment has thus to be varied in the most essential particular; and descriptions of dietetic management must be framed to embrace the different conditions under which the disease is encountered. By this limitation therefore the subject is resolved into a separate consideration of treatment in Europe, and treatment in the Tropics; but a better, and more accurate division is, first, the dietetic treatment of Sprue when fresh milk is available, and second, the dietetic treatment of Sprue when fresh milk is unreliable or unprocurable.

CHAPTER IX.

The Dietetic Treatment of Sprue when Fresh Milk is Available.

Treatment by a Diet of Milk only.

When the food of an adult consists solely of milk, the margin between sufficient and insufficient nourishment is obviously a narrow one. Especially is this the case when vitality has been reduced to its lowest ebb by exhaustion consequent on chronic malnutrition, and when partial starvation is almost an essential condition of cure. The procedure is therefore not one that should be undertaken lightly, or without recognition of the fact that a further serious strain is to be thrown on the strength of the patient; and in every instance of Sprue in which it is adopted, the minutiæ of treatment should be laid down by the physician and followed by the patient with an exactitude and attention to detail which are altogether unnecessary in other disorders. But, so much being understood, there should be no hesitation about undertaking it. Assuming that the milk supply is beyond suspicion, the treatment will be found applicable in the great majority of instances, at all stages of the disease, and, *mutatis mutandis*, at all ages. Supposing the case to be the somewhat typical one of a European patient of middle age, who has been resident in the Eastern Tropics for fifteen or twenty years, who has suffered intermittently from sore mouth, and from characteristic diarrhœa, in whom toxæmia is already established, and who has been sent home in order to

obtain treatment and change of climate, the following procedure may be recommended.

The nature of the patient's illness should, in all cases, be carefully and fully explained; he should be told that he is suffering from Sprue—a term now well understood by tropical residents —that his treatment must necessarily be protracted, and that perseverance and caution are essential to his recovery. He should, if possible, be placed in a nursing home where such cases are usually received, where the importance of dietetic treatment is appreciated, and where there are facilities for keeping an accurate record of his weight, and for the convenient inspection of dejecta. He ought to be clad in woollen underclothes and pyjamas; and, not less with the object of avoiding chills than of securing rest at once to the intestinal tract and to the body, he should remain in bed. To clear the alimentary canal of its undigested and fermenting contents, active treatment ought to commence with the administration of an aperient, and for this purpose, a draught of castor oil and salol, held in suspension by mucilage of acacia and orange-flour water, is most suitable. The following formula has been found effective :—

℞ Mist. ol. ricini B.P. ... ... ʒii
Salol ... ... grs. x.
Mix with trituration.

After the purge the patient may be weighed, and all food except milk should be stopped. To secure accuracy and regularity it is well to furnish the nurse with instructions specifying the exact quantities of milk and the times at which they are to be taken; and for this purpose printed diet cards or slips, on which the necessary information is stated definitely will be found convenient.

These slips may be marked A, B, C, and so on, each being, as far as possible, appropriate to a stage of the disorder, and to

the conditions under which it may have to be treated. With slight modifications, they may be made suitable to almost every case, and their systematical use appears to be of some consequence. Not only are they an accurate index to diet; their employment emphasizes the value of scrupulous exactitude in the administration of food, and impresses the patient with the necessity of method and system. The psychical element in successful treatment is sufficiently remarkable to deserve further special mention, but, in the meantime, it need only be said that in Sprue mental impressions have an altogether exceptional importance.

For the initial stage of treatment by a diet of fresh milk only, Slip A, as reproduced below, is appropriate. From this it will be seen that the first twenty-four days of treatment are divided into six periods of four days each, and that the quantity of milk is increased at the end of each period.

DIET A.

MILK ONLY.

Time	First four days	Second four days	Third four days	Fourth four days	Fifth four days	Sixth four days
	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.
A.M. 7.30... ...	8	8	10	10	14	14
,, 10	8	10	10	12	12	14
P.M. 1	8	10	10	10	14	14
,, 3·30... ...	6	8	10	12	12	14
,, 6	8	10	10	12	12	14
,, 8	6	8	10	12	12	14
,, 10	8	8	10	10	12	14
A.M. 4	8	8	10	12	12	12
	60	70	80	90	100	110

In cold weather the milk should be slightly warmed (90° to 92°); in warm weather it should be given cold.

Unless otherwise directed, the milk should not be sterilized or boiled. It should be taken slowly, sipped, or sucked through a straw.

For a man whose average normal weight is 150 lbs. or less the proper quantity of milk during the first four days of treatment is three imperial pints (60 fluid ounces) every twenty-four hours. When the normal weight exceeds 150 lbs. that quantity may advantageously be increased to 3½ pints (70 ounces) as an initial allowance. If all goes well, after four days the milk is increased, in the first instance to 70, in the second to 80 ounces, and so, at intervals of four days, until 110 or 120 ounces, as the case may be, are being taken every twenty-four hours. The milk should be divided into eight quantities or meals, corresponding, approximately, at least, with those set forth in the diet slip; it should be rich and of good quality, with all its cream, and it should, save in exceptional cases, be undiluted, unsterilized, and unboiled. As specified on the slip, however, if treatment is begun in winter, the milk should be slightly warmed (90° to 92°); in summer it may be taken at its natural temperature. It is further necessary to caution patients against drinking it too quickly, for nothing is more apt to upset the digestion than 10 or 12 ounces of milk rapidly swallowed. A safe rule is to suck it through a straw or glass tube, or to sip it with a teaspoon.

Obviously, the diet which is here laid down as being proper for the first period of treatment is inadequate for muscular exertion of any consequence, and so long as no other food is taken, fatigue is dangerous. To remain in bed during the continuance of the treatment is, therefore, imperative, and all movement which necessitates effort must be forbidden. Inaction, however, need not be absolute, and in the matter of rest as in other things it is advisable to be explicit as to what may and what may not be done. Assuming that the patient is well clad, he may be permitted to get up every morning and evening for half an hour in order to wash, shave, get weighed, &c., and, special precautions against a chill

being taken, to go to the lavatory; but no further exertion should be allowed.

For the first two weeks the patient should not attempt to bathe in the bathroom. Until nourishment is considerably increased it is advisable to limit the general ablutions to a daily sponge, but after he is able to take a more liberal diet a plunge bath may be allowed. The temperature of the bath should not exceed 100°, and in cases where faintness is apt to come on the patient should never be permitted to bathe unattended. Under no circumstances should he walk upstairs. Reading is advantageous, but it is important to remember that fatigue is easily induced by holding a heavy book. Unless smoking irritates the mouth, it should not be stopped, for if the patient is accustomed to smoke regularly, discontinuance causes so much discomfort and annoyance as to interfere seriously with his progress. On the other hand, two or three cigars, or six or eight cigarettes daily, help to relieve the tedium of long confinement and to allay inevitable twinges of hunger. All alcoholic drinks are harmful and must be strictly forbidden.

In most cases 120 ounces of milk daily will be found to be the maximum amount which a patient can digest. In certain other diseases much larger quantities are frequently prescribed without bad results, but in the treatment of sprue, experience indicates that it is inadvisable to carry the increase beyond that limit. If more food appears to be necessary, it should be supplied in some other form.

CHAPTER X.

General Effects of a Milk Diet.

Milk treatment thus carried out doubtless affords to the digestive system the maximum amount of rest which is compatible with safety. But it does nothing more; the nourishment given is only sufficient to keep the patient alive. There is, indeed, no evidence that waste has stopped. On the contrary, the first effect of the treatment is a further marked decrease in weight. The immediate result of placing a sprue patient on a milk diet is that he loses from one half to three-quarters, or even one pound., daily in weight during the first eight or nine days. At the end of that period he is, usually, 5 to 7 lbs. lighter than when he began treatment, and such a loss occurring in a system already attenuated by a chronic disorder, necessarily gives rise to some concern. But there is no occasion for anxiety; by the tenth day, when the allowance of milk has been increased for the second time, the weight curve passes the nadir; it remains stationary for a day or two, and then slowly begins to rise. From this time a quarter to half a pound are put on daily, and, if all goes well, the addition in weight is continuous and regular. In favourable cases as much as a pound a day may be gained.

Hunger is, naturally, a prominent result. Disinclination for food, which possibly has persisted irregularly for some months, disappears about the second day of treatment; the desire to eat manifests itself in sharp pangs, and the patient is apt to rebel at

his limitation to milk. The hunger is, however, of the type peculiar to dyspepsia; it differs from the vigorous and hearty call for food of a healthy man, and is not inaptly described as a feeling of painful emptiness. It is frequently accompanied by nausea, and occasionally a little mucous fluid is vomited; milk, however, is seldom returned. As the patient finds his importunity disregarded, and as the quantity of nourishment is increased, obvious signs of true digestive recovery make their appearance. The general improvement is often remarkable. The appetite assumes its normal character; distension and discomfort subside; the sores in the mouth heal; mucus ceases to form in the throat; lassitude gives place to alertness and interest. A feeling of "fitness" and lightness —a sense of *bien être*—which has not been experienced for many months, slowly returns. Movement is easier; activity, were it permitted, would be welcome. The complexion and conjunctival membranes lose their muddy tints. The laxness and flabbiness of the skin disappear; it becomes smooth and moist, and sits with firmness and elasticity on the structures below. The trunk and limb muscles show a marked increase in size and tone, but the contraction of the superficial tissues—frequently to the great concern of the patient—reveals the full extent of the attenuation. Not until improvement commences can it be realised how much emaciation may be caused by the progress of sprue.

Effect of a Milk Diet on the Intestines and Dejecta.

If the intestinal mucosa is actively catarrhal at the outset of treatment, purging does not stop at once. But the diarrhœa quickly alters in character; it decreases in frequency, and this improvement is especially noticeable at night. Griping, too, is less severe; and gradually the tendency to looseness altogether disappears.

If, however, the condition of the mucosa is quiescent, or if it is one of advanced atrophy rather than of inflammation, the immediate effect of a milk diet is a temporary, but complete, stoppage of the natural evacuations. For the first three or four days there may be no action at all, and relief must be afforded by a mild aperient or a copious lavage of soap and water; but not infrequently, in less advanced or inflammatory cases, regular action of the bowels is established from the first. A tendency to constipation of a somewhat persistent character is, however, the usual result of a milk diet, and occasional laxatives, such as castor oil, pulv. glycyrhiz. co., or pulv. jalapæ co., may from time to time have to be administered.

During a milk diet the appearance of the dejecta is as characteristic of the disorder as in the earlier and untreated stages. If the milk has not been humanised, they are larger and more bulky than ever; they are still almost devoid of colour, and they are now of exceptional consistence, tenacity and weight. From an excess of fat they have a glistening appearance, fatty acids being precipitated and deposited in crystals on the surface. Not infrequently the fat has a low melting point—lower than the temperature of the body—and it is then seen as minute drops of oil. When there is constipation, flakes and shreds of mucus—sometimes streaks of blood—are adherent to the dejecta. During the first weeks of treatment the colour continues the same; the fæces are pale and ashen-grey rather than clay-tinted, and there is generally no evidence of hydrobilirubin in the excreta; but as the patient progresses, although milk continues to be the exclusive food, pigment reappears. The return of fæcal pigment is one of the earliest, as it is the most reliable, sign of commencing convalescence, and improvement may be accurately gauged by the colour of the dejecta.

The solids which form the chief part of the residue of a milk diet are principally unchanged casein and fat. No reliable estimate

of the weight of bacterial growth (considered by Strasburger and Schmidt to be one-third of the total weight of normal fæces) is available, but fermentation is, obviously, less active than it was on a mixed diet. The dejecta are no longer permeated by gas bubbles; even normal aeration is absent; if passed into water, they sink at once to the bottom on account of their excessive solidity and weight, while the marked diminution of microbic activity in the intestine is manifested in the lack of putrefaction and decomposition. There is thus strong *prima facie* evidence of the beneficial effect of a milk diet on the intestine, but that casein and fat should be discharged in considerable quantity is less satisfactory.

It is, therefore, not altogether surprising to find that much has been made of this circumstance by the opponents of milk feeding, and that the treatment has on this account been impugned as unscientific and inefficient. It is urged that because in sprue capacity to assimilate casein and fat is in abeyance, and that as these substances are rejected in unusual quantity, a diet of which they form the chief constituents is obviously wrong. It is further asserted that after the milk curdles in the stomach, only the whey is absorbed, and that the whole of the curd is then compressed into a heavy and compact mass, which the intestine is entirely unable to assimilate.

It may be said at once that it is difficult to find a complete answer to these criticisms. The facts, however, are not stated accurately. It would be unjustifiable and dangerous to feed a sprue patient permanently on whey, and the improvement that follows a milk diet would be impossible were nothing but liquid absorbed. Further, it can be shown that, bulky as are the fæces, a considerable proportion of the solids is digested. The average daily weight of the dejecta in sprue on a diet of 2⅓ litres, or say 80 ounces, of milk is 250 grammes (9 ounces), and of this about 80 per cent. is water,

the dried residue yielding approximately 50 grammes solid matter. The total coagulum of 80 ounces of milk, however, yields not less than 200 grammes (or a little over 7 ounces) dried solids, so that about three-fourths of the total weight of solid would still seem to be assimilated by a sprue patient.

Further analytical research is, however, required to determine these and other questions connected with the bio-chemistry of sprue. Little exact experimental work has been undertaken, and such results as are available are unsatisfactory and insufficient. They are also somewhat contradictory, but it must be confessed that the only reliable figures which have been published tend to support the views of the opponents of a milk diet. Thus, it has been shown by Strasburger and Schmidt,[1] and later by Vaughan Harley and Goodbody,[2] that although in health proteids and fat are present in the dejecta during restriction of the diet to milk alone, their quantity is inconsiderable, and that the absorption of both these elements is quite adequate for nutrition. Again, analyses of the dejecta undertaken by the latter authorities in a case of senile atrophy of the mucous membrane, not of tropical origin (in which the bowel was much attenuated and denuded of epithelium), showed that 92·67 per cent. of the nitrogen and 95·58 per cent. of the fat of an exclusive milk diet had been assimilated.

In sprue, similar experimental corroboration of the value of milk as a food is wanting. In the solitary case in which a careful estimation was made by Drs. Vaughan Harley and Goodbody, it was found that though 88·68 per cent. of nitrogen had been

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[1] "Die Fæces des Menschen," Strasburger and Schmidt, Wiesbaden.

[2] "The Chemical Investigation of Gastric and Intestinal Diseases," Harley and Goodbody. Arnold, 1906.

absorbed, the large proportion of 47 per cent. of the fat consumed was being excreted by the bowels. If these figures are confirmed by further analyses, the only conclusion that can be formed is that

TABLE A.—COMPOSITION OF FÆCES IN HEALTH ON A DIET OF MILK ALONE.

Quantity of milk given. Fluid oz.	Total average weight of dejecta. Grammes	Percentage of water	Nitrogen		Fat	
			Weight in grammes	Percentage absorbed	Weight in grammes	Percentage absorbed
80	135	77	0·84	93·82	2·18	97·40
90	142	76	0·76	95·03	2·95	95·82
100	151	79	1·06	93·76	5·13	95·111

TABLE B.—COMPOSITION OF FÆCES IN SPRUE ON A DIET OF MILK ALONE.

Quantity of milk given. Fluid oz.	Total average weight of dejecta. Grammes	Percentage of water	Nitrogen		Fat	
			Weight in grammes	Percentage absorbed	Weight in grammes	Percentage absorbed
70	255	79	1·47	88·68	12·74	53·01

TABLE C.—COMPOSITION OF FÆCES IN A CASE OF (NON-TROPICAL) ATROPHY OF THE MUCOUS MEMBRANE OF THE BOWEL ON A DIET OF MILK ALONE.

Quantity of milk given. Fluid oz.	Total average weight of dejecta. Grammes	Percentage of water	Nitrogen		Fat	
			Weight in grammes	Percentage absorbed	Weight in grammes	Percentage absorbed
98·7	173	81	1·36	92·67	3·73	96·58

assimilation of casein and fat is essentially defective, and that even although enough may be absorbed to afford sufficient nourishment, milk cannot be regarded as an ideal or even a suitable food. In view of clinical experience, however it is very difficult to accept

these statements or to reconcile them with the results of treatment. An explanation of the marked difference in the absorptive capacity of the intestine in intestinal atrophy of non-tropical origin and in Sprue is still harder to find. In the meantime all that can be said is that, judging from the usual results of a milk diet in sprue it is probable that the case examined was an extreme and exceptional one, and that the figures will be considerably modified by further research.

The tables (page 125), compiled from those published by Drs. Harley and Goodbody, show the composition of the intestinal residua during the exhibition of diets of various quantities of milk, first in health, second in sprue and third in non-tropical atrophy of the bowel.

CHAPTER XI.

Difficulties in the Administration of Milk.

Despite unfavourable criticism, and adverse statistics, however, the results obtained in the treatment of sprue by a milk diet have been so uniformly successful that the procedure is now regarded by those familiar with the disorder as being almost indispensable. There is, in consequence, little difficulty in inducing patients to adopt it, and complaints that milk is nauseating and intolerable are infrequent. As a matter of fact, although there may be considerable repugnance to milk at first, and although a patient may be thoroughly imbued with the impression that it has always disagreed with him, and will necessarily do so again, a fair trial of milk as the sole food, in the great majority of instances, convinces him of his error. After persevering for two or three days, he finds that he likes it, and that it suits him admirably. The comfort which it gives is perhaps the best recommendation, and there is seldom any difficulty in persuading a patient who has had a relapse on more substantial food to return to milk.

But although milk as a rule is readily and easily taken, it is undoubtedly true that there are exceptional instances in which it cannot be tolerated. In a certain proportion of sprue cases, although every precaution is used, milk disagrees violently with the patient, and induces persistent vomiting, pain, and other symptoms of acute dyspepsia.

It need scarcely be said that, in these circumstances, the

question of treatment occasions much anxiety. When such an idiosyncrasy exists, the chances of ultimate recovery are materially prejudiced, and in dealing with sprue patients who cannot take milk, extra care and precaution are invariably demanded. But it is unnecessary and unwise to abandon milk from the first; that ought to be done only as a last resource and after various shifts and modifications in the method of administration have been attempted. Among the expedients that should have a trial the following may be mentioned:—

(1) Not infrequently it is found that hot milk is well borne, although cold or tepid milk is rejected. A method that often succeeds in such cases is to begin with small sips of equal parts of milk and water as hot and as often as they can be taken, and gradually to increase the quantities, lowering at the same time the dilution and temperature if the experiment is successful.

(2) The milk may be diluted with equal quantities of soda water or Apollinaris, or it may be alkalinified by lime-water (1—6), or by bi-carbonate of soda (1 grain to the ounce); or the lime naturally present may be neutralized by the addition of citrate of soda (1 grain to the ounce). Or, again, the curd may be made flocculent by the addition of barley water or rice-tea (1—4). The latter —an infusion of roasted or parched rice, and a familiar household preparation in most parts of the Eastern tropics—is an excellent demulcent and diluent of milk.

(3) The milk may be peptonized. A simple method is to secure a suitable temperature and dilution by mixing 6 ounces of boiling water with 14 ounces of milk, and then adding an eggspoonful of bi-carbonate of soda and two teaspoonfuls of liquor pancreaticus (Benger). The mixture should stand in a warm place for twenty minutes, and be brought to the boiling point at the end of that time. By this process the whole of the albumins and globulins

in the milk are converted into peptones. Peptonized milk demands little digestive effort, and, in the advanced stages of sprue and other atrophic intestinal affections, is a reliable and efficient form of nourishment. It is, however, somewhat repellent to the patient on account of its mawkish and bitter taste—a defect that may be completely neutralized by the addition of soda water.

Another method by which the advantages of alkalinization by lime water and peptonization are secured in combination is to put four ounces of lime water into a pint of milk. Three teaspoonfuls of Liquor Pancreaticus are then added. In the Tropics no further heat is required, and in colder climates sufficient warmth will be secured by placing the jug containing the mixture inside the fender. Peptonization is complete in three hours.

(4) Occasionally, absorption of liquid is the function at fault. The excessive proportion of fluid ingested with a milk diet retards metabolism, and concentration—normally a preliminary to digestion—fails to be effected. The gastric juice is then unable to deal with the over-diluted contents of the stomach, and acute indigestion, with much fluid vomiting, is set up. This condition may sometimes be remedied by evaporating and thickening the milk, or by adding unsweetened condensed milk until it is of sufficient consistence to be tolerated; but in most instances, and especially when pyrosis is prominent, it is advisable to change the diet entirely. A recent case, in which vomiting was incessant, did well on a diet of Devonshire cream and liquid peptones; but as a rule there is hyper-chlorhydria, and it is best to substitute a meat diet without delay.

(5) Prepared or fermented milk may be given. Humanized and sterilized milks, and Koumiss are on sale at most good dairies, and have been recommended as useful adjuncts in the treatment of sprue. Fermented milk does not, however, seem to offer any

obvious advantage, and a general experience is that these preparations are of questionable utility. If the source of the milk is reliable, sterilization should be unnecessary.

Humanized milk, on the other hand, is a most useful alternative to cow's milk. The formula best suited for its preparation in England is that of Frankland, which is as follows: Add to two-thirds of a pint of milk the cream of the other one-third (after standing twelve hours). Curdle the skimmed milk (⅓ pint) with a square inch of rennet by contact for ten minutes. Break up the curd, separating the whey. Heat the whey to boiling point, and dissolve 110 grains of milk sugar in it, then adding it to the two-thirds of a pint (which has the cream of one-third in it).

In the Tropics, or when fresh cream and rennet are unprocurable, Fairchild's peptogenic milk powder conveniently effects the "humanization" of milk. It is sold by most chemists, and a measure and directions for use are supplied with each bottle. If fresh cream is not to be had, condensed or "Highland" cream is a fairly satisfactory substitute.

Humanized milk, though it contains, bulk for bulk, less proteid nourishment than cow's milk, has a high value in calories, and as it is also more digestible, it is therefore better suited to the exceptionally inefficient and asthenic digestion of advanced Sprue. A point of interest in connection with the use of humanized milk in sprue, is that the dejecta during its use are very much less bulky than when unaltered cow's milk forms the principal diet.

(6) WHEY may be given as a substitute for milk. In many other diseases it has long been favourably known as a satisfactory temporary diet; while in some—such as arterio-sclerosis, chronic nephritis, and heart affections—the continued administration of whey over a considerable period is claimed to exercise definite curative effects. The use of whey in the Tropics is necessarily

somewhat limited, but in the French naval and military hospitals in Cochin China it has been employed in the treatment of Sprue with excellent results. Alone, however, whey is an insufficient food, and, if continued for more than a few days, its use is not unattended by danger; but, in combination with milk, or with milk and fruit, it often proves a satisfactory and efficient temporary diet. By the French physicians it is given in the same way as milk; a litre of fresh whey is placed beside the patient in the morning, and he is instructed to sip it slowly and to occupy two or three hours in consuming that quantity. When it is finished a fresh supply is brought, and this is repeated *ad libitum*. Four or five litres (150 to 180 ounces) can be taken during the twenty-four hours. By this diet, it is claimed, vomiting and diarrhœa are speedily checked, and when these symptoms have been brought under control, three or four eggs beaten into milk, or lightly boiled, are added to the daily allowance of whey. In some cases this method may serve as a satisfactory introduction to more nourishing dietetic treatment, but there are many objections to the routine use of whey. Regarded as a food it is unsatisfactory in that it contains an excessive proportion of water, and an inadequate percentage of nutriment. In the Tropics cheese is seldom made, and whey is usually unprocurable. Whey, too, cannot be prepared from condensed milk, and if fresh milk of good quality can be obtained, it is advisable in the first place to give it in some other form. Gastritis and vomiting can, in most cases, be controlled by the internal and external use of ice, by rest, and by nutrient enemata, but if these fail, whey, if available, may be tried. In no case, however, should it be continued as the sole food for more than six days.

The employment of all these substitutes must be regarded as being at the best a *pis aller;* and during the use of any of them

endeavours should be made from time to time to determine whether toleration for natural milk has been re-established. Unless that is secured within two weeks, or unless fresh fruit can be added to the dietary, the continued use of boiled, sterilized, or prepared milk is inadvisable. During the treatment of sprue, scurvy must always be remembered as a possible complication, and it is unnecessary to say that the timely recognition of that condition is exceptionally difficult, and that the risk involved by its occurrence may be very grave.

CHAPTER XII.

Treatment of Sprue by a Diet of Milk and Fruit.

Of recent years the systematic treatment of the more chronic forms of intestinal disorder by a liberal allowance of fruit has gained much favour. It has been found that in many different conditions, such as catarrhal enteritis, colitis, atony of the colon, and chronic dysentery, marked benefit frequently results if the patient is put on a regulated diet, of which fruit is a chief constituent. In disorders where it would appear probable that the administration of fruit of any kind would have a prejudicial effect, it has been found in practice that not only are considerable quantities of the softer varieties of fresh fruit readily tolerated, but that in many cases they have a definite curative effect. Especially is this true of the treatment of Sprue, and, of the many remarkable features of the disorder, perhaps not the least remarkable is the manner in which improvement takes place after the addition of fruit to the dietary.

In most parts of the Eastern Tropics, fruit has long been employed as a dietetic remedy in intestinal disease. The method is, indeed, one of great antiquity, for the use of bael and other fruits in India and the farther East are described in native systems of medicine which antedate European discovery and conquest by many centuries; while the routine treatment of Sprue by a diet consisting entirely of fresh fruit—now generally employed by Dutch physicians in Java—is based on the methods in vogue

during Hindu ascendency in Cambodia and the Eastern archipelago.

The adoption of fruit as a remedy by Europeans has, however, been mostly empirical, and the repute in which the treatment is held is, perhaps, altogether due to its actual success. It was tried at first with many misgivings, and in opposition to authoritative opinion, but it is now generally admitted that the best and most permanent results in the management of Sprue cases can only be attained by a diet of fresh fruit, given regularly and systematically, and in combination with milk.

Whenever practicable, therefore, the following procedure should be adopted both in Europe and the Tropics :—After the patient has been for a short time on a simple milk diet, he should have a specified weight of fresh fruit with three of his "meals" daily. As a general rule, the addition of fruit is best deferred until the effect of milk by itself has been ascertained, and, in moderately severe cases, fruit should not be allowed until milk has been the sole food for at least a week, and unless all symptoms of digestive inefficiency and disturbance have disappeared. Should there be dyspepsia or diarrhœa, the change must be deferred, and the milk should be continued as the exclusive nourishment until full digestive capacity has been restored.

STRAWBERRIES.—Of the many varieties of fruit which have been used with success, strawberries are incomparably the best. Apart from their conspicuously antiscorbutic properties, they possess, when given in combination with milk, a stronger and more definite remedial influence in Sprue than any other fruit. The quality does not, however, appear to be altogether a specific one; probably the form in which the natural fruit acids are presented to the mucosa is the important consideration. We know, at least, that when strawberries are taken in conjunction

with milk, lactic acid is set free in the intestine and that a radical antiseptic action may be thus effected in a situation where it is urgently required. The circumstance that strawberries are more efficient at the beginning of the season than later on, when much of their acid has been converted into sugar, appears also to support the view that the fruit acids are an important and material factor in the utility of the remedy.

DIET B.

MILK AND FRUIT.

TIME.	FIRST FOUR DAYS		SECOND FOUR DAYS		THIRD FOUR DAYS		FOURTH FOUR DAYS	
	Milk	Straw berries	Milk	Straw-berries	Milk	Straw-berries	Milk	Straw-berries
	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.
7.30 a.m. ...	10	—	10	—	14	—	14	—
10 ,, ...	10	¼	12	½	12	1	14	1
1 p.m. ...	10	—	10	—	14	—	14	—
3.30 ,, ...	10	¼	12	½	12	½	14	1
6 ,, ...	10	—	12	—	12	—	14	—
8 ,, ...	10	¼	12	½	12	½	14	½
10 ,, ...	10	—	10	—	12	—	14	—
4 a.m. ...	10	—	12	—	12	—	12	—
	80	¾	90	1½	100	2	110	2½

The strawberries should be crushed, and eaten with caster sugar and cream in the ordinary way.

If strawberries are unprocurable, approximately the same weight of ripe bananas, "William" pears, grapes, or three-quarters of the weight of ripe apples may be substituted. The effect of all fruit, however, must be watched, and if there is discomfort or indigestion it must be stopped pending further instructions.

When available, strawberries should be commenced as soon as possible. The effects of a milk diet will be sufficiently apparent after the second increase; that is to say, when the patient has been taking 80 or 90 ounces of milk daily, as the case may be, for four days. In place of the further addition then due, three-quarters of a pound of strawberries may be given in three portions, and

increased, *pari passu* with the milk, as set forth in the diet slip, every four days, until two or three pounds, or even more, are taken daily. Method and regularity, as in the case of milk diet, must be carefully observed, and when the patients have reached the fruit stage it is advisable to provide them with a new diet slip, such as is here shown (Diet B). The *rationale* of the treatment should be again explained, and the necessity of accurately adhering to the quantities prescribed should be pointed out.

The strawberries must be carefully selected; they should be fresh, clean, and not over-ripe; they may be crushed, and eaten without removing the pips, with sugar and cream in the ordinary way. Fresh strawberries only should be used; jam and other forms of the fruit are useless.

The season during which strawberries may be procured in England is by no means so limited as might at first seem to be the case. Forced strawberries (which, for the purpose, are fully equal to those grown out of doors) can be obtained from the middle of April or earlier. They are then somewhat expensive —generally about 3s. 6d. or 4s. 6d. a pound—but so efficient are they as a remedy that, whenever possible, the question of cost should be disregarded. There is usually a short interval after the crop of hothouse strawberries is finished, and before the garden fruit makes its appearance, and during this interregnum it may be necessary—it is, indeed, often advantageous—for the patient to return to milk. From the beginning of June strawberries are to be had in abundance in the South of England until the end of July; in the northern counties, and in Scotland, until the end of August or the middle of September. They should be continued as long as they are procurable, and no effort should be spared to obtain them in the best condition. If there is any difficuly about the supply, patients should be sent to places where they are easily obtainable. In the Southern Hemisphere, where excellent straw-

berries are grown, they come into season during October and November; and as there is now good steamship communication between Australia and Eastern Asia, patients who come under treatment at that time of the year, and who are able to travel, are frequently advised by physicians in sprue districts to proceed thither in order to obtain the fruit. Several patients who were sent from Malaya to Tasmania and New Zealand, without exception, have done well, although there were unmistakable indications in the Tropics that they were slowly drifting into a hopeless condition, and although facilities for the supply of proper food on the voyage were far from satisfactory.

When strawberries are unobtainable, other varieties of food may be given in combination with milk, but they are, at least so far as results are concerned, inferior substitutes. On no fruit does weight increase so rapidly and regularly as on strawberries, and on none is the character of the nutrition so satisfactory and progressive.

CRANBERRIES resemble strawberries in natural acidity and chemical composition, and have been successfully employed in America in the treatment of Sprue. Although the fruit grown there is of exceptional size and quality, cranberries are distinctly inferior to strawberries in nutritious value. To render them palatable and to neutralise their harsh and acrid taste, cranberries must be cooked with a considerable quantity of sugar. As added carbohydrate and cooking usually counteract the beneficial action of fruit, this would appear to be a distinct disadvantage. The following comparative analysis is from the Government Bureau of Chemistry, Washington :—

	Water Per cent.	Protein Per cent.	Fat Per cent.	Carbohydrate Per cent.	Ash Per cent.
Strawberries	85·9	0·9	0·6	7·0	0·6
Raspberries	84·1	1·7	1·0	12·6	0·6
Blackberries	86·3	1·3	1·0	10·9	0·5
Cranberries	88·9	0·4	0·6	9·9	0·2

RASPBERRIES and BLACKBERRIES have also been prescribed with success on the Continent and, in a few instances, in England. As their season is later they may be found useful when strawberries are no longer procurable, but both blackberries and raspberries contain a somewhat larger proportion of carbohydrate than is desirable.

Of other substitutes that may be employed, the softer and more succulent kinds of fruit are preferable to hard and fleshy varieties; grapes, oranges, pears, bananas and apples, in the order mentioned, being most frequently employed. Stone-fruit, however, should be used with caution; cherries, greengages, and peaches have been recommended, but, although they have sometimes been found suitable, they are generally regarded as being of questionable value, and are condemned by most authorities. In one case in my own experience stone-fruit was found very effective. It was that of a lady who had been sent to Australia for treatment, but who arrived too late for the strawberry season, and who was treated by a diet of milk with nectarines, apricots, and peaches, on which she rapidly improved, and ultimately recovered.

In combination with milk, ORANGES often give excellent results; the finer varieties are much relished by sprue patients, and as a remedy they are equal, if not superior, to any other fruit obtainable during the winter months in England. Their nutritive properties are, however, somewhat unsatisfactory, and distinctly inferior to those of bananas, pears, and apples. On a diet of milk and oranges, the expected increase of weight does not always take place, and it is always slower and less uniform than when the former fruits are used as adjuncts. The refreshing and antiscorbutic effects of oranges are, on the other hand, highly beneficial, and in the advanced stages of the disease, when

toxæmia is prominent, these qualities are especially valuable. Only the juice and finer parts of the trabecular fibrous tissue should be swallowed. In most cases a patient can take two to three pounds of oranges daily without discomfort.

GRAPES. — Fresh grapes, either hothouse or imported, are obtainable in England all the year round, and, in default of strawberries, prove, in combination with milk, a satisfactory substitute. The sugar in grapes varies greatly in different species; in some it amounts to 30 per cent. of the weight of the juice, but the best varieties for the treatment of sprue are the medium sweet grapes such as Muscats (green) and Hambro or Gros Colmar (black). The pips and skin should be rejected. Relish for grapes does not last so long as for strawberries; patients soon tire of them, and are frequently unable to eat the prescribed quantity, while during their use nausea and dyspepsia are common. If, however, there is no serious digestive disturbance, an endeavour should be made to continue, and the grapes may be alternated with oranges or other fruit. As a rule not more than two pounds of grapes can be taken daily, although three or four pounds of strawberries are by no means an unusual quantity. In the Tropics fresh grapes can seldom be obtained in a satisfactory condition.

The treatment of sprue by a diet of milk and grapes must not be confused with the procedure usually known as the "grape-cure," which is employed in some disorders of metabolism, deficient excretion of nitrogen, &c. In this, from one to eight pounds of grapes are taken daily, between ordinary meals, an important part of the treatment consisting in making the patient gather his own grapes, and take a certain amount of exercise. The diet acts as a laxative and diuretic, and is sometimes of great remedial value in the particular conditions for which it is prescribed. During the grape-cure, larger quantities of grapes than is possible in

sprue seem to be assimilated without difficulty. In some recent researches on the treatment of hepatic cirrhosis and oliguria, Cavazzani reports[1] that the best results were obtained by a diet of five pounds of fresh grapes, with other food, *per diem*, and that relish for the fruit was well maintained for several weeks.

PEARS are reported to have been used with much success in Holland and Germany as adjuncts to a milk diet in Sprue. Their therapeutic value appears, however, to have been less evident in England, for although they are superior to many other varieties of fruit, and although relish for them persists longer, they have never gained much favour as a dietetic remedy. Probably English experience of them is insufficient, for if pears are in season and in the best condition, they may unquestionably prove of great service. Only the better and softer varieties—such as the William or the Doyen de Comice—should be employed. Pears are grown plentifully in China and Japan, but even the best varieties are hard and woody, and they are quite unsuited for sprue patients.

BANANAS are now to be obtained in excellent condition at home at all seasons of the year. As they are a product of the Tropics, their employment will be discussed with that of other tropical fruits.

APPLES, when fully ripe, are well tolerated in sprue, and are a useful and pleasant addition to milk. Only the finest quality of "eating" apples—such as Blenheims and Newtown pippins—should be used; they must be carefully selected and prepared, cores and pips being removed. Apples seldom give rise to digestive disturbance, and, weight for weight, they are more satisfying than other varieties of fruit. At first, one or two may be given daily, but few patients are at any time able to assimilate more than one pound or one pound and a quarter of apples daily.

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[1] *Riv. Crit. di Clin. Medic.*, 1907, Nos. 2 and 3.

CHAPTER XIII.

THE DIETETIC TREATMENT OF SPRUE, WHEN FRESH MILK IS UNAVAILABLE, OR UNSUITABLE.

BY A DIET OF MEAT ONLY.

WHEN milk fails to have the desired effect, or when a fresh and reliable supply is unprocurable, a diet of meat, to the exclusion of all other food, often gives excellent results. It has, indeed, some advantages over milk; the latter, although affording complete nourishment for infants, is an insufficient permanent food for adults. In proportion to solid contents, milk contains an excess of water, whilst it is defective in iron and other important constituents. Dilution, however, is not a serious disqualification, for in sprue, digestive requirements usually approach those of infancy, and an excess of fluid is generally advantageous. But for other reasons, the choice of an efficient alternative diet in the treatment of Sprue is highly desirable.

The employment of milk has also been actively assailed by many physicians, who contend that in this and other intestinal disorders a diet consisting entirely of flesh and flesh products is superior, both in theory and practice, to any other. Doubtless, as has already been seen, many arguments, practical as well as clinical, may be adduced in support of their views. Meat is easily assimilable, the residuum nearly approaches the natural dejecta of an adult, and the use of animal food is, as a rule, less apt to be followed by

constipation. Again, as was shown by Pawlow,[1] meat normally excites a rapid flow of gastric juice—the highest rate of secretion occurring immediately after flesh has been eaten, while after milk the maximum is not reached until the third hour. Since in the treatment of sprue the administration of milk is practically continuous, the delay which thus takes place in coagulation and peptonisation is obviously detrimental to assimilation. Moreover, in most places in the Tropics, meat is always obtainable, either freshly killed, or frozen and imported, in a more or less satisfactory condition.

On the other hand, in the Tropics as elsewhere, a diet of flesh alone soon becomes nauseous, and in ordinary circumstances it is difficult to give enough nourishment in this form to prevent a serious decrease in weight. A pound of fresh minced beefsteak contains approximately 145 grammes of proteid, 31 grammes of fat, and practically no carbohydrate; the total yield of calories being only 885, as against 1,560 in 80 oz. of milk. It is therefore necessary that the daily ration should be not less than two pounds of flesh. That is, apparently, an excessive amount, but it is a characteristic of Sprue that a distaste for meat is less marked than it is in health; and many patients can take that quantity from the beginning, while others, to whom it is repugnant at first, are able, with a little effort, to overcome their dislike. On a meat diet, too, the initial loss of weight is less than when milk is the sole food, although, as a matter of fact, this advantage is more apparent than real. But when progress begins, the gain in weight, if not so rapid, is equally regular, while intolerance is rare and relapses are infrequent. A further point in favour of meat is, that it is unnecessary to adhere to a strict *régime* for so long a time as it is when treat-

[1] "Work of the Digestive Glands," Pawlow; translated by W. H. Thompson.

ment is by means of milk; additions and variations may be attempted sooner, and less rigid exactitude in following directions is requisite.

When it has been decided to put a patient on an exclusive diet of meat, it will be found, as a general rule, that beef and mutton are preferable to all other kinds of flesh. Veal, if plainly cooked, is insipid and distasteful; it is, moreover, apt to set up diarrhœa. Pork, in any form, is inadmissible. Chicken, in many parts of the Tropics, is often the only flesh obtainable, and though of small nutritious value, and, therefore, unsuitable for use for any considerable time, has the advantage of being easily assimilated. Meat, when intended for a Sprue patient, must be selected with special care; the muscular tissue should be red, firm, and juicy, and there should be a small quantity of external fat. Flesh in which there is a deposit of intermuscular fat has a higher food value, and when cooked yields a more nutritious stock than lean meat, but "streaky" beefsteak is seldom obtainable in the Tropics. Preserved or salted flesh of any kind should never be used.

Glandular tissues, such as liver, kidneys, &c., are to be avoided, but sweetbread is a savoury and useful variation in a Sprue diet. In this connection, it may be mentioned that a diet composed largely of liver was formerly employed as a remedy for Sprue in some parts of the Eastern Tropics. Probably for the reason that the gland is the first viscus to be obviously affected in the human patient, bouillon made from fresh ox-liver suggested itself as an appropriate remedy to some of the older physicians, and the method gained considerable local repute in Ceylon as a successful "cure" for Sprue. For a time it was in such vogue that a large number of patients, European as well as native, consented to be treated by a diet which consisted solely of partially cooked minced liver. The results, however, do not appear to have been commensurate

with the discomfort and unpleasantness of the treatment, for it soon fell into disfavour, and has long been abandoned.

As a general rule, all meat should be lightly and plainly cooked. In exceptional instances it may be necessary to use raw beef juice, scraped meat, and similar preparations, but there are many objections to the employment of uncooked meat, not the least serious, especially in the Tropics, being the danger of superimposing a tænia infection on the disorder which is under treatment. Preferably, too, when at all practicable, meat should be given in solid form. Minced or pounded beef, and thin slices of lightly cooked sirloin are infinitely more nutritious and suitable for Sprue patients than beef-tea, soups, or extracts. A word of special caution is necessary as to the employment of preserved meat, some brands of which are widely advertised in the Tropics as being specially adapted for dietetic feeding. Probably without exception, tinned and preserved meats are of questionable origin, and a series of experiments recently carried out at the laboratory of the Faculty of Medicine in Paris has shown that many of them are innutritious, useless, and dangerous for invalids.

Treatment by a diet exclusively composed of fresh meat should commence and be carried out much in the same way as in the case of milk. After a preliminary aperient, the weight of the patient should be noted; he should then be instructed to remain in bed and to keep warm, all food except lightly cooked minced beef being withheld.

To prepare minced beef in the way most suitable for a Sprue patient, 2 lb. of rump-steak or fillet are minced with 2 oz. of suet in a mincing—not a sausage—machine, or on a block by a large two-handled chopper. After thorough division and incorporation, the mass is sprinkled with fine salt, divided into six equal portions, and stored in a covered vessel. When an ice-chest is

available, it should be utilized, as in this way, even in the hottest climates, meat may be kept until it is perfectly assimilable, and each portion may be freshly cooked as it is required—two very important considerations in preparing food for invalids. When wanted, one portion is placed by itself in a small buttered sauce-pan, and cooked, with constant stirring and shaking, over a very slow fire, until the red tinge of the meat has just disappeared. If too dry, a very little thin stock, or a small piece of butter, should be added, but care must be taken that the meat does not become sodden and pulpy. The distinctive characteristics of properly prepared minced beef are that it is moist, but at the same time "free"; and that the particles of meat are fairly large, granular, and discrete. If too dry, they are corky and indigestible; if too small, and if too much liquid has been added, the dish becomes a flavourless and unappetising mess.

When properly prepared, minced beef will be taken with relish for a considerable time, though patients will certainly refuse to touch it when stewed until it is soft and pultaceous. One portion, the weight of which may have been reduced by cooking to about 4 oz., should be given every three hours; convenient times being 7 and 10 a.m., 1, 4, 7, and 10 p.m. Before each meal half a pint (10 oz.) of warm water, rice-water, or toast-water, should be slowly sipped, but no other food of any sort is to be allowed. The minced meat is served by itself; toast, bread, rusks, &c., must be strictly forbidden. Twice daily, two or three cups of lightly infused China tea, with a little fresh lemon juice instead of milk, and, during the night, toast water may be given, but nothing else is necessary.

The quantity suggested (32 oz. meat and 2 oz. suet) can generally be taken every twenty-four hours by a patient whose normal weight is about 150 lb. It is, however, a full allowance, and in some instances it may have to be reduced. Even pro-

portionately to the body-weight, ladies are seldom able to tolerate so much meat, and nausea is more readily induced by this diet than it is in men. In practice, the amount suitable for individual patients must be estimated for each case, the decision being chiefly influenced by the normal body-weight, by the natural taste or disinclination for animal food, and by the effect of the diet. A general rule as to quantity is that as much meat as can be assimilated without marked discomfort may be given, and that in those instances in which more might be taken, 2 lb. (raw weight) of beefsteak should rarely be exceeded.

Another point of importance is that although as much as 2 lb. of meat be taken daily, even that quantity cannot with safety form the sole food for so long a time as milk. In the treatment of Sprue by a meat diet, however, a shorter course is generally sufficient; and, if all goes well, after six or eight days it is advisable to modify the exclusive character of the food. When there is marked improvement, instead of one of the morning portions of meat, one or two lightly boiled eggs, without toast or bread, may be given, and, in the evening, another portion of red flesh may be replaced by a fried sole or whiting (Diet C). After a week's favourable experience of this change, roast chicken may be substituted for the midday meal of meat, and an orange, banana, or a few grapes once or twice daily, may at the same time be added to the diet. No other carbohydrate, however, should yet be allowed; but after another week the food should be improved by the addition of vegetables, toast, rusks, biscuits, &c., and in this manner be brought gradually to conform more closely to an ordinary invalid diet (Diet D).

In the treatment of Sprue by meat, regularity and accuracy are quite as important as when a milk diet is adopted; and slips, stating the permissible quantities and changes of food, will be found convenient and useful. Specimen slips are appended.

DIET C.

Modified Meat Diet (*a*).

Time.	
7 a.m.	6 oz. tea.
7.30 a.m.	One or two lightly boiled eggs; if eggs cannot be taken, protene or sanatogen.
	6 oz. tea.
	One orange or pear, or ½ lb. grapes.
10 a.m.	10 oz. barley water, with a few drops of lemon or lime juice.
10.30 a.m.	4 oz. minced beefsteak.
12.30 p.m.	10 oz. soda water, Apollinaris, or Perrier water.
1 p.m.	4 oz. roast or boiled chicken.
	2 oz. boiled or stewed cabbage, celery, seakale, French beans, or fresh lettuce or tomato salad.
4.30 p.m.	6 oz. tea.
5 p.m.	4 oz. minced beefsteak.
7.30 p.m.	10 oz. barley or toast water.
8 p.m.	6 oz. grilled or fried sole.
10 p.m.	10 oz. hot water or barley water.

The tea should be good China tea, and should be infused for not more than two minutes. A small quantity of milk and sugar may be taken with it if desired.

DIET D.

Modified Meat Diet (*b*).

Time.	
7 a.m.	6 oz. tea.
7.30 a.m.	Two lightly boiled eggs, one thin slice of toast and butter, 6 oz. tea. One orange or banana.
10 a.m.	10. oz. barley water.
10.30 a.m.	4 oz. minced beefsteak.
12.30 p.m.	10 oz. Apollinaris water.
1 p m.	4 oz. fowl, rabbit, sweetbread, or calf's head, with 2 oz. stewed celery, seakale, cauliflower, cabbage, French beans, or salad.
4.30 p.m.	10 oz. of tea, two or three rusks or Bath Oliver biscuits with butter.
7.30 p.m.	4 oz. boiled or baked fresh fish, with white sauce; 10 oz. Apollinaris water; a slice of toast and butter.
10 p.m.	10 oz. barley water.

The tea may be given with milk or sugar.

Four oz. of fowl is roughly represented by the "wing portion" of a moderately sized fowl. It may be roast, boiled, or fricasseed.

Barley water is made by boiling a tablespoonful of pearl barley in a pint of water for three or four minutes; a few drops of lemon or lime juice and a little white sugar are added.

RAW MEAT JUICE.—In severe and advanced cases of sprue, when the mucosa of the stomach and intestines is atrophied and fibrosed, digestion is frequently so impaired that cooked flesh of any kind cannot be taken, and it is necessary to have recourse to a diet consisting principally of raw meat juice or meat pulp. In order to prepare meat juice, 2 lb. of carefully selected fillet, or fresh beefsteak, or if beef is unprocurable, 2 lb. of mutton, are freed from fat, tendon, aponeurosis, &c., and finely minced. When the morsels are so small as to be separately almost imperceptible, the mass is placed in a mortar, with 2 oz. of water, to which 20 minims of dilute hydrochloric acid have been added, and is then vigorously bruised by a pestle. Fibrous tissue is further eliminated by passage, with pressure, through a wire sieve, and the pulp adhering to the outside mesh is scraped off and added to the juice. About six fluid ounces of juice can usually be expressed from 2 lb. of meat of good quality by this method, and if that amount is not obtained at first, the mass should be again moistened and pressed until the quantity is made up.

Whenever possible, meat juice should be prepared from fresh beef. The bottled preparations which are alleged to be genuine extracts of uncooked beef, expressed and concentrated without the aid of heat, are mostly unreliable and unsatisfactory. There are, however, some exceptions. Experience of a product named Carnine Lefrancq (Etablissements Fumouze, 78, Faubourg St., Denis, Paris) is favourable. It is stated to be a raw meat extract concentrated in the cold and *in vacuo*, and it is claimed that

each tablespoonful reproduces in liquid form the nourishment contained in 100 grammes of beefsteak.

In cases where raw beef juice has to be given, continuous feeding is necessary at first, and of the fresh extract so prepared a teaspoonful should be administered to the patient every quarter of an hour. When tolerance is established, the quantity may be gradually increased until a tablespoonful or more can be taken every half hour, the nourishment being regularly augmented, and given at considerably longer intervals. Repugnance to meat juice or pulp is almost invariable, and—an exception to the usual communicative policy—it is best to conceal the nature of his food from the patient. The taste may be masked by the addition of a little salt and a few drops of raspberry vinegar, or other fruit juice.

EXTRACTS OF MEAT.—In less extreme, but still serious cases, where a meat diet is indicated, cooked and preserved extracts, soups or jellies may sometimes be employed with advantage. Many of these products now on the market are prepared on a thoroughly scientific basis, and with special reference to the requirements of hot climates, and as they are usually to be obtained at most places in the Tropics, they form convenient substitutes for fresh meat. In more than one case of advanced sprue, when fresh meat was unobtainable, I have known life to be unexpectedly sustained, and ultimately saved, by those preparations. It must be borne in mind, however, that to give nourishment in this form can only be a very temporary measure, and that in no sense can it be regarded as a permanent method of treatment. Adopted merely to tide over a crisis, extract of meat must be supplemented at the earliest possible opportunity by milk, solid meat or other more substantial food ; and in advanced stages of the disease, when assimilation and absorption are seriously affected, the adminis-

tration of meat juice in which the albumen has not been coagulated by heat, is preferable to any other system of feeding.

MEAT IN CHRONIC DIARRHŒA OF UNCERTAIN TYPE. — In many cases of a somewhat different kind the employment of large quantities of meat, and the almost absolute limitation of carbohydrates, may also be highly advantageous. In the Eastern Tropics the physician is frequently consulted as to a chronic form of intestinal trouble, of slight but persistent severity, which it is difficult to refer with certainty to a definite intestinal area. Undoubtedly, the majority of these cases are sequelæ or aborted instances of sprue, but many of them are dysenteric, and have their origin in amœbiasis. The patients are generally men of active and vigorous habits—planters, as a class, are particularly liable to this form of disorder—who have been resident in the Tropics for some years, and who have been accustomed to an outdoor life. The usual history is that, after an attack of acute diarrhœa, which was somewhat dysenteric in character, there remained a tendency to periodic recurrence. At such times the motions, although unlike those of Sprue, were unusually frequent in the morning ; the dejecta were copious, without evidence of intestinal fermentation, and they contained much mucus, but rarely blood ; a predominant feature in many cases being the passage of considerable quantities of gelatinous matter almost by itself. The patient remains in fairly good health, and during the attacks, which occur once every two or three months, or even more frequently, he seldom takes to bed. As a rule, the mouth is unaffected, although there are sometimes small but uncharacteristic sores on the tongue. The prognosis in such cases might seem to be unfavourable, but it is not so in reality ; for an almost complete withdrawal of carbohydrates, an abundant diet of meat, a copious supply of alkaline mineral waters, and abstinence from stimulants,

usually result in a complete and permanent recovery. The diet should consist of fish, eggs and lightly cooked meats, chops or beefsteaks, with warm water, beef tea and Apollinaris water. Butter may be used in preparing the food; fruit and green vegetables, which contain no starch, may be allowed, but no peas, beans or potatoes may be taken; bread, cake, puddings, &c., are strictly forbidden. If the patient cannot satisfy his appetite by meat alone, as is frequently the case, he is to be told that the only permissible course is to eat more meat, and meat only, until he ceases to be hungry. If plenty of fluid is given at the same time, this *régime* may be kept up for a month, or even longer, with the best results to the intestinal condition, and with little discomfort beyond the annoyance which is caused by a persistent alkaline taste in the mouth—an almost invariable consequence of a meat diet. As a rule, no further medication is necessary to effect a cure.

CHAPTER XIV.

Effects of a Meat Diet.

General.

Milk, although an incomplete food, may, without obvious detriment, constitute the sole source of nourishment for many months. On the other hand, a diet composed exclusively of flesh, or of meat products, if continued for over thirty days, produces definite and characteristic effects. The consumption of animal proteids by healthy men to the exclusion of carbohydrates is, almost invariably, attended by great loss of weight and by frequent derangements of the renal, hepatic and circulatory systems. In the Tropics, however, and, especially, during the treatment of Sprue and some other intestinal disorders by a meat diet, these latter effects are seldom apparent. It may be difficult to keep up the body-weight, and to maintain satisfactory nutrition, yet, if the supply of fluid is in sufficient abundance, there is, as a rule, little interference with general health or systemic function. The quantity of meat that may be taken for prolonged periods with impunity is astonishing; metabolism seems to be complete, the urine shows no marked excess of nitrogen, the liver and kidneys act freely and efficiently, and appetite is unimpaired. It is by no means easy to furnish an explanation of this exceptional tolerance for meat, but it is possible that it may correspond, in some measure at least, to the severity of precedent depletion.

Effects of a Meat Diet on the Dejecta.

In Sprue, if there is no intestinal inflammation, the substitution of proteid for mixed food is usually followed by immediate relief of the symptoms. When the new diet proves acceptable and is well tolerated, diarrhœa is arrested and regularity may be at once established. The average amount of contained water in the dejecta is less than on any other food; they become scanty and resemble those of a fasting man. The usual daily weight of sprue dejecta during a meat diet is 40 to 50 grammes, as compared with a weight of 220 grammes when the patient is taking ordinary food, and 120 to 140 grammes, which in health is the normal weight of the residue from a mixed diet. The motions are formed, but are seldom scybalous or hard; and they are dark brown or blackish in colour, without characteristic or offensive odour. Fat is often seen, generally as minute droplets, but sometimes as crystals of fatty acids. The reaction is alkaline—a point of some interest, when the acidity of the discharges in untreated cases is borne in mind. Little is known as to the effect of the disease processes of sprue on the absorption of nitrogen, but, in all probability, that is seriously impaired. In health, on a meat diet, excreted nitrogen has been shown to be very low, with high absorption; but, in sprue, the only available analyses indicate that a large quantity of nitrogen is excreted, while absorption, like that of fat, is extremely defective.

A limited amount of ulceration does not materially influence the character of the excreta, but when there is inflammation, either general or circumscribed, diarrhœa may continue for some days after the patient is put on a meat diet, and may require special treatment by sedatives and antiseptics. The dejecta, however, quickly lose their distinctive sprue characteristics, and, if the diet is continued, usually become normal within a few days.

CHAPTER XV.

TREATMENT OF SPRUE BY PRESERVED MILK WITH MEAT PEPTONES, CASEIN PREPARATIONS, AND LIMITED CARBOHYDRATE DIETS.

MILK AND PEPTONES.—As a rule, mixed diets in Sprue give unsatisfactory results, and combinations of meat with milk are found to be as unsuitable in practice as they are unscientific in theory. There are, however, some preparations which, when given in conjunction with milk, especially in the later stages of the disease, may prove of service, and amongst the most important of these are the peptones of meat. Genuine peptones are variously prepared, but in most cases they are the albuminoid constituents of fresh meat, peptonised by acidulation under pressure, and deprived of their salts. Several reliable brands of peptones are on the market.

The treatment of Sprue by milk and peptones was originally introduced by Féris, of the French Naval Medical Service, and is known in Cochin China, where for many years it been held in high repute, as Féris's cure. In an article[1] contributed to a discussion as to the most suitable alimentation for tropical patients suffering from the recently described endemic diarrhœa, Féris claimed, so

[1] "Traitement par la peptone de l'enterite des pays chauds," *Arch. Navales de Med.*, October, 1882.

long ago as 1882, that on a diet of milk, to which *poudre de peptone* (*Catillon*)—a well-known French preparation—had been added, the period from the commencement of the treatment of Sprue until the formation of solid dejecta was shortened, and the liability to relapse materially lessened.

In cases treated by milk and peptones according to the method of Féris, the period was found to be twelve days, and the percentage of relapse sixteen, while in cases of similar severity treated by a diet of milk only, the average time is stated to have been twenty-two days, relapses occurring in no fewer than 64 per cent. of them. The latter figures do not, of course, correspond with our our own experience of milk treatment, but there is some uncertainty as to the milk which was employed in these test cases. It appears to have been fresh milk obtained at Saigon, a product that might well give very different results to those which follow the use of milk in England; but Féris contended that the combination of peptones with condensed milk was as efficacious as when fresh milk was used, and that the average duration of treatment was the same. His article was written with special reference to the feeding of patients in an advanced stage of the disease, when little beyond preserved milk, and such stores as could usually be obtained in the Tropics and on board ship, were at the disposal of the physician.

Attention having been directed to the success which attended Féris's method, and further experiments in feeding sprue patients in the ships and hospitals of the French Naval Squadron having given equally favourable results, treatment by a diet of peptones and condensed milk soon became popular. The method is still largely employed in Cochin China, but general experience in other Settlements, although on the whole satisfactory, does not coincide in every particular with that of the French physicians. It is

possible that better results would have followed the use of a somewhat more liberal allowance of nourishment than was laid down by Féris. The quantities recommended by him, viz., 3 oz. of liquid, or 1 oz. of solid peptones, with 1 litre (37 oz.) of milk, seem insufficient for a daily ration, and most English authorities are agreed that, if nutrition is to be satisfactorily maintained, at least twice that quantity of milk is necessary. As a temporary measure, however, Féris's treatment by solid peptones and condensed milk may undoubtedly prove to be of great value. In my own experience, many patients in an advanced stage of sprue have undertaken a voyage of several weeks duration on no other food than peptones and condensed milk, and have ultimately made good recoveries.

Although the conditions have greatly improved, the question as to what is the most suitable nourishment for Sprue patients, when preserved food has to be utilized, has lost none of its importance. In the Tropics, numerous cases have still to be treated under very unfavourable conditions—and in most of them recovery depends on the ability to procure proper food. It is seldom possible to get the fresh diet that would be most likely to suit the patient, and only too often the preserved preparations which are to be obtained are altogether unreliable. As questions of feeding by raw meat juice, by milk and peptones, and similar methods, arise only when patients are very seriously ill, the quality and condition of their nourishment are of the utmost moment, and there should be no hesitation in stating definitely what may be done, and what preparations, proprietary or otherwise, are likely to be suitable.

Considerable advances have been made of late years in the manufacture of meat peptones, casein, &c., for invalid consumption, and several of the more recent products are excellently adapted for Tropical practice, and are well known as dietetic com-

modities in the East. Of solid peptones, SOMATOSE, a light yellow, granular, tasteless powder, soluble in water, and easily digested, is one of the most suitable for the treatment of Sprue. This product is manufactured by the British Somatose Company, Queen Victoria Street, London, and is now to be obtained at most of the principal centres in the Tropics. One oz. and a half to 2 oz. of Somatose, in divided quantities, should be given with 60 oz. of condensed milk daily. It is claimed that Somatose seldom or never sets up gastro-intestinal disturbance,[3] that it consists mostly of albumoses, that it does not decompose in hot climates, and that it contains no carbohydrates. Somatose can also be procured in a liquid form.

Carnrick's peptonoids, another well-known solid form of beef peptones, although an excellent preparation, would seem to be less suitable for sprue cases, in that it is said to contain a considerable proportion of carbohydrates. Koch's and Kemmerich's solid meat peptones are largely used in Java and the Netherlands Indies.

Of liquid peptones, there is an even greater variety. Brand's beef peptone, Darby's fluid meat, Liebig's peptone, Valentine's meat juice, Benger's peptonized meat jelly, and Carnrick's liquid peptonoids are reliable preparations, and although differing in composition and nutritive power, all may prove serviceable. They are, however, less effective in the treatment of Sprue than solid peptones. Widely advertised preparations with fancy names and an agreeable flavour should be avoided; in most cases they contain little proteid, and are composed largely of brown sugar, while in some there is a considerable percentage of alcohol. It must be borne in mind also that the administration of peptones, even in health, is occasionally followed by diarrhœa, and that

[3] Stevenson and Luff, *Lancet*, September, 1899.

genuine peptones, as a rule, have a somewhat unpleasant taste, and do not readily commend themselves to patients.

CASEIN PREPARATIONS.—Certain recently introduced proprietary preparations of casein have also acquired a considerable reputation as dietetic remedies, and are now frequently employed in the treatment of Sprue. Of these, the best known are PROTENE, which appears to be practically pure casein; PLASMON, in which there is over 80 per cent. of proteid, and SANATOGEN, which is composed of 95 per cent. of casein and 5 per cent. of glycerophosphate of soda. The advantages of these preparations in Tropical practice are that they keep well, that they are concentrated, and that, weight for weight, they are more nourishing than meat proteid. Further, it has recently been shown that casein possesses definite alkalinifying properties, and that during digestion it is itself able to fix and neutralize considerable quantities of acid. It is, therefore, indicated as a diet that is likely to prove of service in those cases of gastric disorder common in the Tropics, in which acid dyspepsia, sour eructations, and heartburn are prominent features. As a matter of fact, casein has already shown itself to be a dietetic remedy of great value in the general treatment of Sprue, and in other forms of intestinal disturbance and sepsis. It has, moreover, been established by the researches of Salkowski[3] and Schmidt[4] that the residue of casein left after digestion does not decompose, and that in itself it possesses important antiseptic and antifermentative properties. In all probability, it is to the constituent casein that the efficacy of milk in the treatment of Sprue is largely due; and in view of their many remarkable qualities, there can be little doubt that preparations of casein are,

[3] Salkowski, *Klin. Wochenschrift*, No. xlvii.
[4] Schmidt, *Zeit. für Physiol. Chemie.*

in the future, destined to take an even more important place than they now do in the dietetic medicine of the Tropics.

LIMITED CARBOHYDRATE DIETS.—At a certain stage in progressive Sprue, carbohydrate digestion, defective from the first, fails altogether, and it is then impossible for the patient to take any food which contains starch. The ferments which convert it into sugar are obviously at fault, for, while a certain amount of sugar may be absorbed without difficulty, starch always remains unassimilated. In such instances, if the patient persists in taking farinaceous food, acute pain and diarrhœa invariably ensue, and the whole of the starch is ultimately excreted in a fermenting and decomposed condition. It occasionally happens, however, that, as a consequence of treatment by meat juice, or by milk with peptones, or by casein, the power of carbohydrate digestion partially returns, and it may then be advisable to substitute for proteids alone a diet in which there is a certain proportion of starch. The change should, of course, be gradual, the carbohydrate at first being peptonised, malted, or otherwise rendered assimilable; and the most convenient method is to supplement a diet of meat peptones and milk by one or two meals of some suitable infants' food. A large number of these foods—practically all proprietary —are on the market. They differ principally in the amount of starch which they contain, and the extent to which it has been malted; some of them, for instance, are entirely composed of milk products; others have a certain proportion of unchanged starch; while in others there is a considerable percentage of starch which is partially or completely malted. At first, only those in the last group should be allowed; and it is best to begin by selecting a food in which the starch is altogether transformed, gradually passing to less malted starch until ordinary farinaceous food, such as corn-flour, prepared barley, groats, &c., in which no malting has taken place, can be digested.

Of foods which will be found useful in the treatment of Sprue while capacity for starch digestion is returning are Allenbury Food No. 2 (which contains a very small proportion of malted wheat flour); Carnrick's soluble food (malted wheat flour 37 per cent.); Benger's food (wheat flour, with pancreatic diastase, which converts most of the starch during preparation); Mellin's food (completely malted); and Albany food (starch not completely malted). In the Tropics, as at home, these are familar nursery specialities, and as they are packed in tins specially designed for hot climates, they keep fairly well, and are readily obtainable in places where there is a European population. Their preparation, too, gives little trouble; the directions are clearly stated, and are simple and easily followed. After an experimental diet of malted food has been continued for a week, rusks, sponge cakes, thin toast, Bath Oliver or plain biscuits may be given, and if good butter is obtainable, bread and butter in small quantity will do no harm. Other forms of starchy food are, however, to be avoided. Even after carbohydrate digestion is thoroughly re-established, the articles in the following list should be banished for many months, or even years, from the dietary of a Sprue patient: potatoes, nuts, pastry, cake (of all sorts, except sponge cake), new bread, rice (except in small quantity) and vegetables containing starch, *e.g.*, beans, peas, carrots and parsnips. At this stage, however, it is generally advisable to allow green vegetables or salads, for French beans, cabbage, cauliflower, vegetable marrow, sprouts, lettuce, endive, celery, tomato, &c., if properly prepared, are digested without difficulty.

A word may be added on the use of eggs in the treatment of Sprue. As eggs are almost everywhere plentiful in the Tropics, and as they contain a large proportion of proteid and some fat with practically no carbohydrate, they apparently offer in a convenient form the exact nourishment that is required. It is, how-

ever, another singular characteristic of the disorder is that in advanced Sprue eggs generally disagree, and that they can seldom be taken without subsequent diarrhœa and vomiting. Moreover, in frequency and urgency, the purging and intestinal disturbance induced by eggs are altogether disproportionate to the quantity that have been taken. When given as an adjunct to a strict Sprue diet, one egg is sometimes sufficient to excite symptoms of considerable severity, although in health there was no natural intolerance for eggs, and although they formed an agreeable and regular article of food.

Especially does this seem to be the case when there is extensive denudation of the mucosa; in such instances, although egg albumen may be readily taken as albumen water, the yolks, either by themselves, or when beaten up with milk or in soups, almost invariably disagree. A reason for this incapacity to digest eggs in Sprue is somewhat difficult to find. Personal idiosyncrasy to special articles of diet—a peculiarity which is nowhere better exemplified than in the case of the comparatively large number of persons who in health are unable to take the smallest particle of an egg in any form—is difficult of satisfactory explanation. Raw eggs, as is well known, pass, almost unchanged, through the stomach to the intestine, although lightly boiled eggs undergo partial gastric digestion[5]; and it is possible that with disordered function, uncooked eggs may prove to be active irritants to the lower bowel. But it is more probable that in Sprue and other morbid conditions special albuminoid poisons are produced during the metabolism of albumen by the altered intestinal juices, and that in liability to such a noxious transformation the proteid of egg offers a marked contrast to that of casein.

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[5] "Food and the Principles of Dietetics," R. Hutchison, M.D. Arnold.

It has been seen that eggs are often advantageously prescribed with an exclusive diet of whey, and it is possible that, if fat is restricted, their assimilation may be less difficult, but they must always be given with caution in the acute stages of Sprue. Improvement is, however, like the restoration of carbohydrate digestion, followed by a return of capacity to digest them. In the period of convalescence eggs may be completely and easily absorbed by the intestine, and they are then a valuable and nutritious food. At first they should be given lightly boiled, as ordered in diet slips C and D, but later, the quantity and method of preparation may be varied to suit the taste of the patient.

CHAPTER XVI.

Treatment of Sprue by a Diet of Fruit alone.

It was, as has been seen, in the Dutch Indies, that a diet of fresh fruit was first systematically employed as a remedy for Sprue, and Van der Burg, who had an unrivalled experience of the disorder as it occurs in Java, and whose published account[1] remains one of the best as it was one of the first descriptions of Sprue, considered a diet of fruit to be quite the most efficient method of treatment, either at home or in the Tropics.

Some of the instances cited by Van der Burg are certainly remarkable. One patient, a lady who was *in extremis*, who could take no food, and who, to all appearance, was kept alive only by champagne and morphia, he had the satisfaction of seeing restored to a moderate degree of health by no other means than the administration of fresh fruit. Another, who was also in the last stages of Sprue, made a good recovery on the somewhat bizarre diet of sliced peaches and cucumber juice. He considered the indigenous fruits of Java, mangosteens, rambutans, lichees, &c., to be specially suitable for employment as dietetic remedies, although when he could obtain them he also utilized sub-tropical fruits, such as apricots, peaches and grapes. The success of Van der Burg's method in the Tropics was remarkable, and on his

[1] Van der Burg, "Indische Spruw," (Aphthae tropicæ), eene monographie. Batavia, Ernst and Co., 1880.

return to Holland he continued to prescribe the fruit treatment with similarly satisfactory results for numerous invalids who had returned from the East, suffering from a more or less advanced form of the disease.

For use in Europe, Van der Burg recommended grapes, and although English physicians now generally order fruit in combination with milk, an exclusive diet of grapes is still in considerable vogue on the Continent. Many surprising, but well-authenticated cases of the cure of Sprue by fruit diets have been recorded, and the quantity of grapes and other fruits which have been given with impunity and success is not the least astonishing feature of these reports. Dr. van Leent, of Amsterdam, has related the case of a retired officer who had contracted sprue in Java, and who had been very ill for two years after his return to Europe without seeking advice. During a treatment of four months duration, this patient lived on nothing but ripe pears, taking them in gradually increasing quantities, until his daily consumption amounted to forty goodly sized fruit. The actual weight is not stated, but it could not have been less than 9 or 10 lb. This treatment appears to have been as agreeable as it was effective, for although the patient remained well, he voluntarily repeated his "cure" annually when pears came into season.

Speaking of the treatment of Sprue by this method in Cochin China, M. Cuneo, *medecin-en-chef* of the French Naval Squadron in Eastern waters, says: "It was with considerable misgiving that I agreed to try a diet of fruit, and it was also a surprise to me that there was no disaster to record. On the contrary, in the great majority of cases, there was immediate and marked improvement. In view of these results, and by the light of experience gained, the treatment was accurately defined and became a routine method. Every morning 2 lb. of grapes of a fine thin-skinned variety

were given, and the patient was advised to eat them slowly; when finished, more were given, and the quantity was gradually increased until *10* lb. could be taken daily. On this diet there was no intestinal disturbance; on the contrary, a tendency to constipation was soon manifested, and the secretion of urine was copious."

Similar corroboration of the efficacy of Van der Burg's method has been furnished in abundance by Continental physicians, and the treatment of Sprue by a diet of fruit alone is now regarded as a safe and generally satisfactory procedure. Probably, however, on account of the facility with which the milk and milk and fruit treatments can be carried out at home, a diet of fruit alone has never become popular in England. It is in the Tropics, where fresh milk is often unobtainable, and where suitable fruit is generally to be had in unlimited quantity, that the method will be found most valuable.

CHAPTER XVII.

Treatment of Sprue by a Diet of Tropical Fruit and Preserved Milk.

Of the indigenous fruits of the Eastern Tropics, those which have been most successfully employed in the treatment of Sprue are bananas, pine-apples and papayas. These differ considerably from each other in botanical characters, and in therapeutic action, but they have a common advantage in that they all give satisfactory results and that they can be obtained fresh and in excellent condition throughout the year. Other fruits less familiar at home, because they scarcely bear export to Europe, and because their production is limited to special seasons, but which have also been largely employed as dietetic remedies, are mangoes, mangosteens, rambutans, lichees, anonas, figs, avocadoes, pumeloes and sapotas.

Bananas.—In the Eastern Tropics, some thirty or forty varieties of edible banana are grown, and these different species vary greatly in size and weight. Some of the larger kinds, known in America as plantains—a name usually applied in the East Indies to the yellow banana—weigh, without the rind, about 4 oz.; the common banana—the pisang rastali of the Malays—weighs about 1½ oz., while the small, sweet variety known, from its yellow pulp, as the golden banana—the pisang mas—does not exceed 1 oz. in weight. A still smaller, and less common, species, the exquisitely flavoured pisang jari, weighs less than half an ounce.

Although, from the comparatively large amount of carbohydrates which they contain, bananas might be expected to prove an unsuitable food, it has been found in practice that in the Tropics they are often more efficient than any other fruit, and that any or all of the kinds mentioned may be successfully employed in the treatof Sprue.

As has been seen, in combination with fresh milk, they are occasionally utilized at home, and form an important element in a treatment which is, on the whole, fairly successful. But, since only the less delicate species of bananas are suitable for export, the fruit obtainable in Europe is of poor quality, and the results are, in consequence, less satisfactory than in places where the finer varieties can be procured in abundance and in the best condition. In the Tropics, and wherever fresh milk and strawberries are unavailable, condensed milk and bananas are, perhaps, the best substitute for them that can be easily obtained, while the diet is generally relished by patients and may be continued for an indefinite time. Bananas, too, are as nutritious as they are palatable. If the patient can take a full quantity, his body-weight increases more rapidly on a diet of bananas and milk than on any other fruit (strawberries alone excepted), and as they keep well and require no preparation or cooking, they are an exceptionally convenient food for use when travelling or at sea.

Against these advantages, two somewhat serious disqualifications must be taken into account. They are, first, that idiosyncracy with regard to bananas is not uncommon, and that whatever the quality or condition of the fruit, many patients are naturally unable to digest them; and secondly, that the contained starch may be insufficiently changed to render the fruit assimilable when carbohydrate digestion is impaired. It is of the greatest importance, therefore, that the fruit should be quite ripe. Unripe bananas contain

a large proportion—about 25 per cent. by weight—of starch, the whole of which, by the process of ripening, is ultimately changed into invert sugar, and should any starch be left unconverted, it is probable that the diet, apart from idiosyncracy, and, especially in advanced cases, will set up acute dyspepsia and lienteric diarrhœa. It is, however, always a matter of great difficulty to predict the effect of a diet of bananas; starch conversion does not invariably take place concurrently with ripening, and one variety may be readily tolerated when another acts merely as an irritant. Their action, therefore, must necessarily be closely watched, and before committing a patient to a diet of bananas, or allowing him to start on a voyage, it is essential to make sure that they can be taken without ill-effect. In any case an alternative diet should always be available.

BANANAS AS THE SOLE FOOD.—When it has been decided to treat a sprue patient by a diet of bananas only, he should, as in the case of other exclusive diets, remain in bed. After a purge, and a subsequent fast of twelve hours duration, he should begin by taking one medium-sized banana every two hours, and with the exception of water, he should take no other food. After two or three days, if all goes well, the patient will generally be able to take fifteen to eighteen moderately large bananas daily; and, when it is apparent that the fruit suits him, this quantity may be gradually increased until twenty-four, twenty-six, or even more bananas can be assimilated. No alteration should be made for temporary dyspepsia or diarrhœa; but if they are persistent the diet must, of course, be reduced or changed. In practice, it generally happens that there is a little trouble at first, but as the irritation quickly subsides an effort should always be made to establish tolerance. The excreta which form the residue of an exclusive diet of bananas are seldom characteristic of sprue; as a rule, they are

somewhat loose, of a good colour, and otherwise fairly normal in appearance. In these circumstances, the diet may be continued as long as the body-weight is increasing and the patient is willing to submit to the treatment.

BANANAS WITH PRESERVED MILK.—Although bananas by themselves may thus afford satisfactory nourishment, it is always best, whenever possible, to employ them in combination with milk. In the Tropics, preserved or condensed milk will, in most cases, be the only milk available, but as it is now extensively used both by natives and Europeans, it is everywhere obtainable, and it can generally be procured fresh and in good condition. Careful enquiry is, however, always necessary as to the source and credentials of preserved milk. Innumerable varieties are on the market, some of them of excellent quality, scientifically prepared, and guaranteed to contain all the original cream; others are indifferent; while others, again, are made from skimmed milk, starch, glucose, and other substances, and are altogether deleterious and worthless for invalid feeding.

Preserved milks are of two kinds, unsweetened and sweetened. Of the former, some brands, such as "Ideal," "Bear" "Gianelli-Majno," or "First Swiss" have been found reliable, and for sprue patients these are generally preferable to condensed and sweetened preparations. Unsweetened milk, however, decomposes rapidly after exposure to the air in hot climates, and unless certain precautions are taken, it is apt to cause trouble. As soon as the tin has been opened, the condensed milk should be poured into a clean jug or vessel, which has been rinsed out two or three times with boiling water (no towel or cloth being used to dry it). To this milk three times its volume of previously boiled water is added and the jug is then covered with clean damp muslin, and placed in the coolest place available. Treated in this way, preserved milk

will keep fairly well, but it is seldom safe, even when every precaution has been taken for the prevention of contamination, to use unsweetened milk in the Tropics twelve hours after the tin has been opened.

Although on account of the high percentage of added sugar which it contains, sweetened condensed milk cannot be regarded as an ideal food, the condemnation which, on theoretical grounds, it has received is largely discounted by tropical experience. The consumption of sweetened condensed milk in the Tropics is now very large; it is in general use by the natives for infant feeding; and it is in many cases the only form of milk available for sick-room dietaries. As a rule, babies do very well on it; the robust condition of the native children sufficiently attests its nutritious properties; and, in practice, invalids usually find that, if not very palatable, it is nourishing and convenient. It has the additional advantages that it is less expensive, that it is more readily procurable, and that it keeps better than the unsweetened preparations; and in their absence there need be no hesitation in advising the use of sweetened condensed milk by Sprue patients.

When required for use, the diluted milk should be freshly made by the addition of boiled water, and as the condensed sweetened product is more concentrated than the unsweetened milk, dilution is necessarily greater. There is, however, little trouble or risk of decomposition, for if ants and flies are prevented from getting access to the condensed milk, it will remain in good condition for two or three days after the tin has been opened.

At first, 60 oz. of diluted milk so prepared with twelve to sixteen medium-sized bananas are a usual quantity for a Sprue patient, but as capacity increases, both may be considerably augmented. The nutritious qualities of the diet are naturally less striking than those of strawberries, but when tolerance is once established, the dejecta

soon become normal in quantity and number, and on this convenient and inexpensive *régime* tropical patients are singularly free from relapses and gastric derangements.

But, as has been seen, bananas, with or without milk, are by no means always so satisfactory in Sprue. In a certain proportion of instances, and especially in advanced cases, they disagree violently from the first. Acute dyspepsia, with distressing flatulence, colicky pain, and offensive diarrhœa invariably follow their ingestion, and patients complain bitterly of the nausea and distress of which the diet is obviously the cause. In these aggravated cases it is useless to temporize, and a complete change of food is imperative.

PINEAPPLES.—The cultivation of pineapples has recently become an important industry, and this fruit can now be obtained in abundance almost everywhere in the Tropics throughout the year. In the Western Hemisphere, pineapples are grown chiefly in the West Indian Islands and in the adjacent regions of North and South America; the fruit raised in the Bahamas, Port Rico and the South of Florida enjoying the highest reputation for excellence and flavour. In these districts elaborate methods of cultivation are employed; particular care is taken as to the access of sunlight, and the plants are reared in partial shade, obtained either by means of trees, or, preferably, by an arrangement of boards on posts which intersect the beds.

In the East Indies, pineapples are everywhere plentiful. In Malaya, where large crops are grown, no special care is taken in cultivation; the young suckers are planted out in the open, and, without particular attention, they attain maturity in two or three months, and produce fruit of exceptional size and quality. Preserved in sugar, and packed in tins, Straits pineapples, even though much of the distinctive flavour of the fresh fruit has

been lost in the process, are now in active demand in European markets, and their cultivation and export are important features in the commerce of Malaya.

As a food, pineapples are of small value. They contain very little proteid—less than ½ per cent.—but, when ripe, they are rich in sugar, not less than 10 or 12 per cent. being the usual proportion found on analysis. Acidity, even in fully ripe pine-apples, is a marked feature, and amounts to 0·40 or 0·50 per cent. The sugar, about half of which occurs as invert, and half as cane sugar, is the only important nutritious constituent of pineapples, and the esteem in which the fruit is so deservedly held is due almost entirely to the aromatic and agreeable subacid flavour.

Pineapples are not generally recommended for the dietetic treatment of Sprue. By some authorities they have, indeed, been expressly condemned, but a somewhat extensive experience of their use has shown that when employed with proper precautions they may be a most valuable adjunct to treatment. They are unsuit-able for employment as an exclusive food, and should be given only in conjunction with milk. The quantity of the fruit that can be taken by the patient is also at first small, and it must be very cautiously increased. In practice it is advisable to begin with a small piece, weighing not more than 2 oz., of well-ripened Victoria pine (known in the Straits Settlements as the "Mauritius" pine), and to repeat it at intervals of six hours throughout the day. About 80 oz. of diluted condensed milk, distributed over twenty-four hours, should be given at the same time. To divide a pine properly the best way is to cut it up longitudinally into four sections; the rind, pips, and core are then sliced away, when the proper weight of pulp, which should be soft and juicy, though not over-ripe, will be left in each quarter.

Although this treatment of Sprue, like other methods, is some-

what uncertain, a diet of pineapples and milk is often followed by exceptionally good results, and it is worth a trial even in Europe when other fruit, such as strawberries, cannot be obtained, and when pineapples are plentiful and good. A slice of fresh pineapple, given occasionally at intervals in the course of other dietetic treatments, is generally beneficial, and is always much relished by patients.

The excess of cane sugar which is used in the method of preserving pineapples at present in vogue renders the tinned fruit altogether unsuitable for the treatment of Sprue, but as there does not seem to be any reason why pineapples should not be effectively preserved without the addition of large quantities of syrup, it is probable that some more satisfactory process will be introduced.

PAPAYA.—In the search for a satisfactory tropical substitute for strawberries, the advantages of the papaya (*Carica papaya*, papaw) should not be overlooked. The fruit is common in the Eastern Tropics, and, though not generally considered to possess many attractions, is in constant domestic use as a wholesome and inexpensive dessert. In appearance and shape the papaya somewhat resembles a large melon, and, when fully developed, weighs 2 or 3 lb.; the rind is smooth, green and tough; the pulp copper-coloured, soft, and homogeneous. There is a longitudinal cavity in the centre of the fruit, which is filled with aromatic seeds, not unlike black pepper, and these are held in some local repute for their laxative and carminative action. It has also been claimed that the juice of the papaya, and the alkaloid papain obtained from the unripe fruit and from the young shoots, are endowed with special digestive properties, but it is very doubtful whether they possess any solvent action on albumin.[1] Popular

[1] *Pharmaceutical Journal*, 1896, i., 180.

belief in the digestive efficacy of the papaya is, however, strong, and the leaves are frequently employed by native cooks, with somewhat dubious results, to diminish the toughness of tropical beef steaks.

In some ways the papaya is, perhaps, the best of all fruits for the dietetic treatment of intestinal disease in the Tropics. It is easily obtained, it is eminently digestible, and although reputed to be decidedly laxative, in sprue, at least, it seldom disagrees. The only disadvantage is that the fruit has a somewhat mawkish flavour, and although taken with relish by some patients, it is very distasteful to others. On account of the difficulty of continuing it for any length of time, papaya is seldom employed as the sole diet, but in advanced Sprue a daily diet of 60 to 70 oz. of milk, and 1½ lb. of ripe papaya, in three portions, has proved effective. Generally speaking, it is in such instances—in the later stages of the disorder, and where there is marked digestive incapacity—that papaya will be found most serviceable.

Among other tropical fruits which are used in the treatment of Sprue, various species of the ANONA family have been highly commended by Dutch physicians in Java, the sour-sop (*Anona muricata*, Malay—*durian blanda*), and the custard apple (*Anona reticulata*, *buah anona*) being most frequently employed. The sour-sop is an elongated, irregularly shaped fruit, bluntly pointed at one end, and round at the other; it is about 6 in. in length, and is covered by a rough green rind, on which there are numerous spiny hairs. The interior is filled with seed-sacs, each containing a brown seed, with a small quantity of white pulp, which has a peculiar and characteristic odour and a strongly acid flavour. Despite its somewhat pungent taste, the sour-sop enjoys some popularity as a breakfast fruit, and is much used as a flavouring for ices and beverages.

The custard apple suffers less by transport than most other tropical fruits, and is now a familiar object in shop-windows in

England. It is round, and somewhat larger than an orange; the rind (which is green at first, but becomes brown with ripening), is hard and fibrous, and is marked off into characteristic protuberant sections.

The edible pulp, scanty, viscid, and closely adherent to numerous black seeds, is sweeter than that of the sour-sop, but although much liked by some people, is generally considered to have an indifferent flavour, and is of small nutritious value. About three-fourths of the fruit are inedible. Both varieties of anona are, however, said to be efficacious in Sprue, and although they can seldom be taken in sufficient quantity, even with milk, to be considered satisfactory foods, they are frequently prescribed in Java, either combined with some other fruit, such as bananas or mangosteens, or as part of a modified meat diet. If it is decided to give either variety of anona a trial, four or five may be taken daily, two or three in the morning and one or two in the afternoon.

The delicious AVOCADO or ALLIGATOR PEAR (*Persea persea*), which is so highly prized in the West Indies for its luscious flavour, has now been successfully introduced into the Eastern Tropics, and deserves attention as a fruit which will probably prove a highly efficient dietetic remedy in Sprue and other wasting diseases. So far, it has not been produced in sufficient quantity to allow of extended trial, but as cultivation is extending rapidly, further opportunities will soon be available. No less than 10 per cent., by weight, of the pulp of the avocado consists of fat in an assimilable condition, and although proteid is somewhat deficient, and the proportion of acid variable, the fruit promises to be of very great value in special alimentation.

Strictly speaking, the edible FIG is not a tropical fruit, but green figs of excellent quality are to be obtained in the North of India, in Australia, and in other sub-tropical regions where Sprue

occasionally occurs. In combination with milk, figs have found favour in America, where they have recently been employed as a dietetic remedy in the treatment of intestinal disease of non-tropical origin. Their virtues are, however, somewhat questionable, and, in Sprue it is doubtful whether they should be used at all. Containing, as they do, some 15 per cent. of sugar and 3 per cent. of fat, they are undoubtedly highly nutritious, but in view of their marked laxative tendency, and in the absence of more extended experience of their effect, one hesitates to recommend them. It is possible, however, that, on further trial, figs may be found to justify the statements that have recently been made, for nothing is more true in connection with remedial measures in Sprue than that it is the unanticipated which succeeds.

THE PUMELO (*Citrus decumana*).—Although, apparently, the pumelo attains greatest perfection in sub-tropical districts, this fruit is now largely cultivated throughout the Eastern and Western Tropics, and its wide distribution is indicated by the number and variety of names which it has received. Known in the West Indies as the Shaddock (a term derived, by popular repute, from the name of the introducer), it is most familiar to residents in Eastern Asia as the pumelo, a word traceable, it is said, to Pamplemousses, a district formerly noted for the production of the fruit. The greatest of all the citron family, the pumelo resembles nothing so much as a green orange magnified four or five diameters, pulp sacs, partitions, and rind being all proportionately enlarged. The fruit varies in flavour, chemical composition, and quality—the latter depending to a great extent on the district where it is grown, and on the care that is devoted to cultivation. The Fuh-kien province of China stands in special repute for the production of pumeloes, and, when obtained in good condition, an Amoy pumelo is, undoubtedly, a most excellent fruit. On the other hand, pumeloes

grown in Cochin China and Malaya, where but little attention is given to the trees, are indifferent in quality; the fruit is generally small, and the pulp dry, harsh and bitter. As, however, the better varieties bear export well, Amoy pumeloes can be readily obtained during the season at most ports which have steamship communication with China, and, in combination with milk, they are largely employed throughout Eastern Asia in the treatment of Sprue. In Java they are often prescribed as an exclusive diet. The juice of a good pumelo contains about 10 per cent. of sugar, and almost 3 per cent. of citric acid; it is thus considerably sweeter than the juice of the lime, and more acid than that of the orange. It is claimed that the curative effect of pumeloes in Sprue is superior to that of oranges, but as they contain practically no proteid or fat, an exclusive diet of pumeloes is inadequate for nutrition. As an adjunct, however, to condensed milk the value of the fruit in the treatment of Sprue in the Tropics is unquestionable. It may be noted that an infusion of the pulp and rind of the pumelo, prepared in the same way as bael sherbet, is often employed by native physicians in the East Indies as a remedy for chronic dysentery and diarrhœa.

The MANGO (*Mangifera indica*) is naturally indigenous in the forests of Southern Asia, where it produces, in the uncultivated state, a small, bitter, and generally uneatable fruit. By a careful system of grafting and culture continued through many centuries, the Mango has become the most important and highly prized of Indian fruit trees; and it has been successfully transferred to Tropical Africa, to the West Indies, and to Florida, where, as in India, the fruit is now a valuable economic product. Bombay mangoes have the highest reputation for delicacy of flavour, but they are scarcely superior to those grown in Mysore and Southern India, while fruit of excellent quality is produced in Bengal, Assam, Burmah and

Siam. About the size of a large pear, and of a globular or flattened oval shape, the mango is now so well known as hardly to require description. The rind is smooth, tough and fibrous, and usually dark green in colour, although some varieties acquire yellow and red tints, not unlike those of apples; the pulp is copper-coloured, firm, homogeneous, and closely adherent to a large central stone. The unripe fruit is intensely astringent and acid, but in the process of ripening, essential ethers of peculiar aroma and bouquet are developed. The mango season usually begins in May and ends in July, although fruit of indifferent quality is generally obtainable all the year round.

THE MANGOSTEEN (*Garcinia sp.*), a tropical fruit of striking appearance and exquisite delicacy of flavour, is produced principally in South-eastern Asia, and attains its greatest perfection in the Malay Peninsula, Java, and Sumatra. The fruit seems, indeed, to find congenial surroundings only in these regions, for although frequent attempts have been made to acclimatize the mangosteen in other tropical countries, they have met with but little success. Like most Malayan fruit trees, the mangosteen is non-deciduous, and, in favourable situations, bears fruit twice during the year. As the early, or small, season begins in December, and continues, with some intermissions, until the ripening of the main crop in May, it is frequently possible to obtain mangosteens in good condition for five or six months continuously. When ripe, the fruit is the size of an apple; the rind is thick, easily cut or broken, the section being of a remarkably rich Vandyke-brown colour; the pulp is ivory-white, longitudinally divided into five, six or seven segments, similar to those of an orange, and closely adherent to the seeds, of which there is one in each segment; the taste is delicately subacid and agreeable. When obtained in good condition, the mangosteen is justly considered to be one of the best of all tropical fruits, but as

it is too perishable for export, it can be procured in perfection only in the countries where it is grown.

The RAMBUTAN (*Nephelium sp.*) is the indigenous Malayan representative of the Lichee family, and is a fruit of great delicacy of flavour and dietetic value. Like the mangosteen, it has a decided preference for its native soil, for although grown successfully in other countries, it is only in Malaya that rambutans are to be obtained in the best condition. The trees are very prolific, and during the season, piles of the bright rose-pink, hairy fruit cover the stalls and booths of the native fruit vendors, and form an attractive and picturesque feature of local street life. The pulp is white and firmly gelatinous, with a sweet, faintly acid, characteristic taste.

As dietetic and therapeutic agents, mangoes, mangosteens, and rambutans may be classed together. They all possess considerable remedial efficacy; their action is similar; and in the Tropics they have all been employed with success in the treatment of Sprue. They are prescribed much in the same way as bananas—either alone, or in combination with fresh or condensed milk, or as an adjunct to a modified meat diet, their action being perhaps seen to best advantage when they are given in the advanced stages of Sprue, and when combined with milk. In such instances, a diet of 60 oz. of milk, with three or four ripe mangoes, or eight or ten mangosteens, or thirty rambutans, often proves unexpectedly successful. In less advanced cases, modified Meat Diet C, with the substitution of the tropical fruit for European fruit and vegetables, may prove satisfactory. Mangosteens are frequently employed as an exclusive diet in Java, and although they are defective in nutritious properties, many Sprue patients who have been treated in this way have done well.

Another fruit worthy of mention is the widely distributed SAPO-

DILLA or SAPOTA (Malay, *Chekoo*). About 2 oz. in weight, the chekoo is externally not unlike a freshly dug potato, while the inside closely resembles, both in appearance and taste, an English medlar. The seeds, usually five in number, lie in a small cavity, surrounded by a brownish-yellow, gritty pulp, of intense sweetness. Analysis shows that although, in the chekoo, there is an insignificant amount of proteid, the pulp contains no less than 12 per cent. of sugar in an easily assimilable condition, with 0·125 per cent. natural acidity. The fruit, therefore, is of considerable nutritive value, and when sugar can be taken, proves a suitable diet in Sprue. Chekoos are, however, somewhat too sweet for prolonged use, but as an occasional or alternative food in milder cases, and when modified diet is possible, they are both agreeable and beneficial.

The story of the introduction of BAEL FRUIT into European medicine, and the subsequent failure of that tropical product to maintain a therapeutic reputation in temperate climates, is an interesting and suggestive one. In the East Indies, bael has, from time immemorial, been popularly regarded as a sovran remedy for all forms of gastric and intestinal complaints, and the fruit has been largely employed, both by Europeans and natives, in the treatment of "white" diarrhœa, enteritis, and dysentery. Soon after the occupation of India by the British, the success of this native method of dealing with the endemic dysentery of the country attracted attention, and the treatment of that very prevalent and fatal disorder by a sherbet, or infusion made from fresh bael fruit, became the routine practice in the civil and military hospitals. The results that attended the adoption of the remedy were remarkably successful; mortality was notably reduced, and the average detention in hospital was reduced to less than half the former period. The usual treatment of dysentery by European methods was, at the time, notoriously unsatisfactory and inefficient;

ipecacuanha had not been introduced, and the general practice was to treat all cases by heroic doses of calomel, with frequent blood-letting. The fatality was appalling; and the fact that a so-called sthenic disease, like dysentery, could be successfully treated by dietetic management, and that fresh fruit could be less hurtful than huge quantities of mercury, came as a revelation. The efficacy of bael was, however, at once admitted by the Indian medical authorities of the day, and their writings teem with references to its great virtues as an antidysenteric. In the circumstances, it is not surprising to find that, being regarded rather as a medicinal than as a dietetic remedy, bael should have been placed on the British list of official drugs. Several galenical preparations—ordered to be made from the dried imported fruit—were authorized, and for many years were extensively prescribed in England in the treatment of dysenteric affections. It is remarkable that physicians with Indian experience did not realize the wide difference between the therapeutic effects of the fresh fruit and those of the pharmacopœial extracts prepared in drug factories. In his lectures, Surgeon-General MacLean states that during his term of office bael fruit was the routine treatment for all cases of dysentery arriving at Netley Hospital from India. He does not say whether fresh fruit was specially imported, or what preparations were used, but at other institutions, and in general practice, the liquid extract made in England was chiefly employed. Given in this form, bael fruit entirely failed to fulfil expectations.

Although some physicians, who, like MacLean, were convinced of the alliance between dysentery and scurvy, and in support of their theory, continued to prescribe bael fruit, the remedy was soon found to be of no practical value whatever. After a somewhat extended trial it had to be admitted that the nauseous decoctions and preserved preparations of the pharmacopœia possessed as

little of the efficacy as they did of the fragrance of the fresh fruit, and they quickly fell into disfavour and disuse. Some time later, bael was deprived of the official sanction which it enjoyed, and preparations of the fruit which have been made in England are now seldom prescribed.

It is, however, otherwise with fresh bael in the Tropics; the reputation which the fruit has acquired popularly is still fully endorsed by scientific opinion, and in many widely different types of intestinal disorder, notably in Sprue and in amœbic dysentery, this treatment continues to give results that are uniformly satisfactory.

The Bael (*Ægle marmelos*)—one of the most familiar of fruit trees to Eastern residents—is indigenous and flourishes luxuriantly in Bengal and Southern India; in Ceylon, Malaya, Siam, and Indo-China the trees grow freely, although, compared with the Indian product, their yield is small and of poor quality. In Calcutta—whence large quantities are exported to the Farther East—bael is obtainable in good condition at most seasons of the year, the fruit gathered in the dry months before the monsoon (February to May) being supposed to be specially efficacious. It is usually about the size of a small melon, and is covered by a thick, woody, green rind; the pulp is somewhat like that of the pumelo, but is less juicy, and it has an astringent, although a fragrant and not unpleasant taste. Made into sherbet with sugar it is agreeable and palatable, and in this form is in much demand in the native bazaars as a cooling and refreshing drink. In intestinal disorders the ripe pulp may be sliced and eaten, but the best remedial effects are obtained by the use of the less ripened fruit prepared in the following way: The pulp of a young bael (which generally weighs about a pound) is cut into cubes of an inch square; these are placed in a jug, and covered with an ounce of white sugar; to

this a pint of *boiling* water is added, and the contents of the jug, after being freely stirred for some time, are allowed to settle and cool. Of this sherbet or infusion (which must be freshly made two or three times daily), 30 to 60 oz., or even more, may be given in twenty-four hours. When good milk can be obtained, the administration of milk and bael in advanced cases of Sprue is often followed by remarkable improvement; and when milk is unavailable, bael sherbet may be ordered in conjunction with a meat or modified meat diet, to the great advantage of the patient. Bael may, indeed, be taken with any of the diets prescribed in Sprue, and at any period of the disease, but it is essential that the fruit should be fresh, and that the infusion should be recently made. During convalescence, and when the diet is being increased, the use of bael is specially indicated.

CHAPTER XVIII.

The Treatment of Sprue by Drugs.

In comparison with dietetic measures, drugs are of quite secondary importance in the treatment of an ordinary case of Sprue. Most of the standard pharmaceutical remedies for atonic and inflammatory disorders of the alimentary tract are useless; many are harmful—some actively so; while a few, though of doubtful value as specific remedies, appear, in certain phases and conditions of the disease, to possess a certain beneficial effect. It is seldom, however, that Sprue is free from intercurrent complications; and it is but rarely that the physician can dispense altogether with medicines. Special disturbances, such as acute attacks of diarrhœa, gastritis, intestinal pain, and myalgia, are apt to occur at one time or another in the progress of the disease, and, although these and similar symptoms are by no means inevitable concomitants of Sprue, they may be the cause of much anxiety, and must be promptly met by the administration of suitable remedies. Local medication to the mouth, nates, &c., is also generally necessary; and, during dietetic treatment, laxatives or other intestinal correctives will usually be required.

Apart, moreover, from the treatment of special circumstances and conditions, various drugs have been asserted from time to time to have a definite and specific effect in modifying both the severity of type and the urgency of the symptoms of sprue; and the thera-

peutic claims of these remedies, with the possibilities of others, require examination.

DRUGS THAT SHOULD NOT BE GIVEN IN SPRUE.—Of medicines which, especially in the earlier and more acute stages of the disorder, almost invariably do harm, the most important are bismuth, mineral acids, astringents, iron and arsenic. Yet, as is natural, these are often the very first remedies to be prescribed.

BISMUTH seems to be particularly deleterious. Given on the supposition that the patient is suffering from some non-specific form of gastritis, the remedy acts as an irritant rather than as a sedative; and a not infrequent consequence of a full dose of the subnitrate or carbonate of bismuth is severe pain and violent purgation. To a certain extent this is true of all periods and stages of the disorder; there appears to be a definite antagonism between bismuth and the morbid processes of sprue, and it is a safe rule of practice to exclude it altogether.

The MINERAL ACIDS are scarcely less harmful; they should never be given while there are active manifestations of sprue; but after material improvement has been effected by dietetic treatment, and during convalescence, they may occasionally be of service in increasing digestive tone.

As in the case of other intestinal fluxes, in which undigested matter is excreted, ASTRINGENTS must also be used with the greatest caution. Catechu, kino, and hæmatoxylin, for example, when prescribed with the object of checking the diarrhœa of Sprue, invariably fail to do so; not infrequently, serious complications originate in their use. Experience of some recently introduced tannin derivatives, such as tannigen, tannalbin, and tannoform, is equally unfavourable. It is claimed for these remedies that they pass unchanged through the stomach, and that they are not decomposed into tannin until they reach the intestine. This, under ordinary circumstances, would appear to be a strong recommendation, and

in many intestinal affections is doubtless a valuable one ; but, in the crises of acute diarrhœa which occasionally occur in Sprue, these powerful astringents are always contra-indicated. Absorption and assimilation are liable to be summarily arrested, and the condition of the patient may become, in consequence, one of urgent danger. Astringents are admissible only in the comparatively rare instances in which diarrhœa is due to loss of tone in the mucosa, and should never be given to check the lienteric and irritative flux of Sprue.

IRON and ARSENIC are inadmissible in Sprue. Although frequently prescribed under the belief that the condition is one of pernicious anæmia, or some other type of serious blood disease, the mistake is fraught with danger to the patient. They not only fail to alleviate the symptoms, but diarrhœa, vomiting, and exhaustion, are brought on by their use. The constitutional symptoms of sprue are also intensified, and anæmia with dyspnœa and failure of the peripheral circulation are always prominent in a patient who has been treated by these drugs. Both seem equally deleterious : arsenic is, perhaps, more liable to set up purgation, while the effect of iron is to accentuate gastric symptoms and to increase rather than to diminish the destruction of red corpuscles. Hypodermic medication by these remedies has also been tried, but the results are scarcely less disastrous than when they are given by the mouth. In one case which recently came under observation, and which was a typical instance of sprue, the patient had been treated for anæmia, and in consequence of the disordered condition of the bowels, had received a course of daily hypodermic injections of three-quarters of a grain of sodium cacodylate, with the result that all his symptoms were aggravated. He also suffered severely from localized abscesses, although there was no reason to doubt that asepsis was carefully carried out, and when he applied for treatment his condition was critical. He ultimately made a good recovery on a diet of milk and grapes, without

further recourse to drugs. In Sprue, the phagocytic function appears to be seriously impaired, and hypodermic treatment is, therefore, an undesirable and somewhat dangerous procedure.

INTESTINAL ASEPSIS.—The primary aim of treatment in Sprue is, to render the intestinal contents less septic; and it is mainly on dietetic measures that one must rely to obtain this result. But the question arises, Cannot asepsis be assisted or increased by the administration of germicides? So far as we know, the special *régimes* employed in Sprue check bacterial growth by depriving it of a favourable medium rather than by direct bactericidal action, and it would seem not improbable that their effect might be indefinitely increased by the internal administration of suitable antiseptics. Moreover, putrefaction and fermentation being so gross, the disease presents an unusually favourable opportunity for investigating the potency of intestinal germicides, and it is urged that, under the circumstances, clinical experiments for that purpose are not only justifiable, but imperative. Although intestinal antiseptics have had an extensive trial in Sprue, however, our knowledge has not been materially increased by the result. A few remedies have been found to be capable of appreciably checking bacterial growth, but the treatment of Sprue on these lines has been a failure. On this question, however, the last word has not yet been said, and it is probable that future success in dealing with intestinal sepsis will depend more on effecting an increase of resistance to natural toxins than in the destruction of microbic germs. Methods such as those of Mikulicz-Radecki, who has succeeded in enormously supplementing peritoneal resistance to toxins by injections of nucleic acid[1] are full of promise,[2] and may be an important element in future treatment.

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[1] Mikulicz-Radecki Method, *West London Medical Journal*, July, 1904.

[2] Mayo Robson: *Medical Annual*, "Peritonitis," 1906.

In the meantime, the first steps in intestinal asepsis are to clear away unprofitable material, and to prevent the accumulation of residue in the alimentary canal. For this purpose, although a purgative is generally sufficient, it may occasionally be necessary to order an emetic. Especially in the earlier stages of Sprue, retention of the stomach contents for considerable periods, without obvious discomfort, is of frequent occurrence; and, after an emetic, surprising quantities of undigested food are sometimes returned. The ultimate passage of these masses into the intestine would necessarily be attended by a marked increase in the symptoms; and when their presence has been ascertained by percussion and palpation, there should be no hesitation in inducing vomiting. In such cases, IPECACUANHA is the best and safest emetic. Not less than 20 grains of the powdered root—a quantity insufficient to cause serious depression—should be given. The drug rapidly deteriorates in the Tropics, but the plant is now cultivated in Malaya and Southern Asia, and the root can generally be procured fresh. If fresh ipecacuanha cannot be obtained, the new official liquid extract may be used; it keeps well, and is free from many of the disadvantages of the older preparations; to secure prompt emesis, 20 minims are generally sufficient. The alkaloid CEPHÆLINE, prepared in England from fresh ipecacuanha, being obtainable in tablet form, is well adapted for tropical use, and in doses of a quarter to a third of a grain is favourably known as a satisfactory emetic. Other preparations of ipecacuanha are unreliable in the Tropics, and EMETINE and APOMORPHINE should never be given in Sprue.

PURGATIVES.—Intestinal evacuation in Sprue is best secured by CASTOR OIL. No aperient acts with such regularity and freedom from local irritation, and, in the great majority of cases, it is preferable to all others. SALINES have been recommended, chiefly by French writers, as being effective in removing the viscid mucus

with which the bowel is encumbered. There is no direct evidence that they possess this property in a greater degree than castor oil, and the general experience of English physicians is unfavourable to their use.

CALOMEL was formerly freely prescribed as an alterative and evacuant in Sprue, and it was generally ordered in startling doses. In small quantities and in combination with ipecacuanha, it still enjoys some favour on the Continent as an aperient and intestinal disinfectant, but it is difficult to see on what grounds calomel comes to be recommended. In large doses it is dangerous, and the disqualifications of mercurial salts in the treatment of disorders characterized by stomatitis and anæmia are obvious. Persons of East Indian birth are particularly prone to mercurial intoxication, while there is also little clinical evidence that calomel has any pronounced disinfectant action on the intestinal contents. During the administration of calomel in doses of one-half to three-quarters of a grain three or four times daily, the flow of bile is not materially increased, nor is there any obvious alteration in the character of the dejecta in Sprue. Calomel should never be given when there is œsophagitis.

In view of its almost specific action in Hill diarrhœa the possibilities of PERCHLORIDE OF MERCURY as an intestinal antiseptic in Sprue have recently received attention, and it has been extensively prescribed as a remedy for the latter disorder. It is now agreed, however, that corrosive sublimate aggravates the mouth symptoms of Sprue, while it has little, if any, beneficial effect on intestinal sepsis or on the general condition. It is not surprising that this drug has been generally abandoned and that the same result has attended the use of all other preparations of mercury.

One of the most promising and successful preparations in the promotion of intestinal asepsis in the Tropics is the FREE CHLORINE

AND QUININE mixture originally recommended by Dr. Burney Yeo in his well-known "Manual of Medical Treatment." It is prepared by placing 30 grains of powdered potassium chlorate in a 12-oz. dispensing bottle, and pouring on it 40 minims of strong hydrochloric acid. The chlorine, generated by chemical action, is dissolved by the gradual addition of water during the evolution of the gas; and when the bottle is full, 24 grains of bisulphate of quinine are added to the solution. One ounce of this mixture every two hours is a proper dose.

Flatulence, distension, and other evidences of fermentation in Sprue are undoubtedly relieved by free chlorine, and when these are persistent during dietetic treatment, the beneficial effect of the remedy is unquestionable. But although free chlorine may thus be prescribed to the relief of the patient, independently of diet, it has little influence in controlling diarrhœa, in altering the character of the stools, or in promoting carbohydrate digestion. Probably, as is claimed, a considerable part of the chlorine reaches the small intestine unchanged, and exercises some antiseptic action on its contents. The germicide does not appear, however, to be able to survive the passage of the entire length of the tube, for although Yeo's mixture has been given in more frequent and in larger doses than are recommended, the characteristic odour of chlorine is never apparent in the dejecta of Sprue.

A better prospect of securing comparative intestinal asepsis is offered by the administration of keratin-covered capsules containing vegetable remedies of known bactericidal capacity. So far as personal experience goes, the best results in the treatment of uncomplicated Sprue have been attained by placing the patient on one of the specified diets previously described, and by giving at the same time CAJEPUT, THYMOL, and MENTHOL in keratin-covered capsules. Gelatine capsules each containing 2 minims of oil of

cajeput, ½ grain of thymol, ½ grain of menthol, 1 minim of pure chloroform and 1 grain of the oleo-resin of capsicum, coated with keratin, may be obtained ready for use from Messrs. Duncan, Flockhart and Co., London and Edinburgh. One should be given every six hours. The effect of treatment by this method is more pronounced when the capsules are prescribed in combination with a meat or milk diet, but experience has shown that, with mixed diets also, vegetable germicides are of much benefit, and that these remedies exercise a very appreciable antiseptic action on the contents of the bowel.

SULPHUROUS ACID is a powerful stomachic disinfectant, and there is evidence that it has some effect in controlling intestinal fermentation in the upper bowel. In doses of 20 to 30 minims, it has been successfully prescribed in Sprue to check the diarrhœa which sometimes persists without special evidence of cause, when a diet of milk or meat seems, in other respects, to suit the patient. The disadvantages of sulphurous acid are that it has an objectionable odour and taste, and that it is useless when the septic processes are situated in the colon or lower bowel. It should, however, be borne in mind as a germicide that may render good service in Sprue, as well as in other septic disorders of digestion in the Tropics. Sulphurous acid is usually prescribed with syrup. limonis or syrup. acidi citrici.

Few, if any, of the synthetic remedies, for which intestinal antiseptic properties are claimed, can be used with benefit in Sprue. Experience of SALOL, given with a milk diet, in doses of 10 grains every six hours, is distinctly unfavourable. In one case in which it was tried, the patient had recently returned from the East suffering from occasional diarrhœa, with loose, colourless, and offensive dejecta. Some two years before he had an ulcerated sore mouth, which had been cured by the use of a boracic wash. At the time

there were no other symptoms of Sprue, and the patient had not thought himself ill; no change had been made in his diet, and he had been living somewhat irregularly.

Although there was little doubt about the diagnosis, as he seemed to be in good general health, he was not placed on a milk diet, but was advised to stop alcohol, to restrict carbohydrates, and to take 7½ grains of salol after each meal. On the evening of the first day he complained of irritation, and a burning feeling in the lower part of the abdomen; but the salol was continued until it was apparent that the drug was the cause of the pain and sickness. The urine was not discoloured or otherwise affected. On stopping the salol, and substituting a milk diet for mixed food, with a full dose of emulsio ol. ricini every morning, he got well in a few days and had no return of diarrhœa or other symptoms of Sprue. The case illustrates nothing more, perhaps, than an idiosyncrasy to salol, but it is by no means a solitary instance, and it tends to corroborate a suspicion which is general, that the drug—so valuable in many other intestinal derangements—is unsuitable in Sprue.

Somewhat more favourable results appear to have attended the use of ACETOZONE (Benzoyl-acetyl-peroxide), and of BENZOSOL (Benzoate of Guaiacol)—synthetic remedies which are much employed as intestinal antiseptics on the Continent. Both have been shown to possess a marked influence in restraining bacterial growth in the alimentary canal, and they are stated to be specially effective in Sprue. They may be given in 3-grain and 5-grain doses respectively, and are usually prescribed to be taken with 1 or 2 drachms of lemon or lime juice in 3 or 4 oz. of water. Benzosol is saponified by the gastric secretions, and reaches the lower intestine as guaiacol.

In view of the researches of Metchnikoff on intestinal bacterio-

logy in old age, and of the analogy between the processes of Sprue and senile decay, the possibilities of LACTIC ACID and sour milk as remedial agents have naturally attracted some attention. It is obvious that by a diet of milk, and, more especially, by a diet of milk and acid or subacid fruit, the indications of Metchnikoff for the prevention of toxin formation are to a large extent fulfilled. Metchnikoff established the fact that the *B. acidi lactici*, if swallowed with milk, passes with it almost directly to the lower bowel and colon, and that it there produces large quantities of lactic acid, with consequent coagulation of the milk, and neutralization of intestinal toxins. Attempts have therefore been made to supply the bacillus in a sufficiently virulent form to be effective as a therapeutic remedy, and several preparations designed to act in this way have been recommended by bacteriologists. One of the most recent is SAUERIN, introduced by Messrs. Allen and Hanbury, which is stated to be a pure culture of *B. acidi lactici*, and which is claimed to act efficiently in all septic conditions of the lower bowel. The theory is in itself attractive, and is supported by high scientific credentials, and although time has been insufficient to allow of reliable clinical statistics being collected, sauerin seems to have been successful in the instances[1] in which it has been tried. In at least one case of Sprue sauerin has been efficacious.

The method adopted in this instance was to give, with a modified meat diet—(*a*) one tumblerful (ten ounces) of milk curdled by sauerin four times daily between meals. In preparing it, two pints of milk were heated to 160° F. and poured into a jug that had been sterilized by boiling water. Organisms that might have "got ahead" of the *B. acidi lactici* being thus killed off, the

[1] *British Medical Journal*, October 6, 1906.

milk was allowed to cool to about 100° F., when six tablets of sauerin were added, with two tablespoonsful of white sugar. Curdling was complete in three hours.

Coagulation of milk by lactic acid (which takes place when there is 1 per cent. of acid in solution) seems to be an entirely different process from the curdling which is produced by rennet ferment. In the formation of lactic acid from milk sugar by the bacillus, the casein undergoes partial peptonisation, and the curd is therefore in a highly assimilable condition. Milk naturally curdled by lactic acid fermentation forms an important part of the food of several races in the Eastern Tropics. In Southern India and Malaya, where it is known as "tyroo," it is largely consumed by Chetties, who are high-caste Hindoos, and who eat very little animal food. Members of this community are generally well developed and well nourished, and, in comparison with other classes, suffer little from intestinal disorders. Sauerin may also be given by the mouth in tablet form with a milk diet; if this method is adopted, white sugar should be added to the milk in sufficient quantity to ensure a copious formation of lactic acid.

Comparative asepsis of the lower bowel may also be attempted by the administration of lactic acid *per se* or of one of its salts. Lactic acid is a sour, viscid liquid, which, although miscible with water, has many disadvantages; and for internal use the LACTATE OF CALCIUM is preferable. Given in cachets in 3-grain doses five or six times daily with a milk diet, this salt seems to be of distinct service in Sprue; with a meat or modified meat diet also, it acts well; and if the administration of a drug is considered necessary, calcium lactate is, on the whole, perhaps, the most satisfactory remedy for routine use in ordinary cases. Lactate of calcium should be procured as fresh as possible, as some change, not clearly understood, takes place in its composition. Fresh, it is easily

soluble in water, but gradually it becomes less so, and finally the salt is found to be altogether insoluble. The change in solubility does not, apparently, affect therapeutic efficiency, but, if absolutely fresh lactate is desired, it may be obtained in solution by the use of the following formula :—

℞ Calcii carb. precip. ... ... 3i.
Acid. lactic., B.P. ... ... ♏cxxx.
Aq. ... ... ad. ʒvi. Solve.
One tablespoonful contains 15 grains calcium lactate.

Beyond the general results of treatment, there is no exact method of estimating the actual value of intestinal antiseptics, or of making comparisons between them. It is difficult to allow for individual conditions, or to eliminate error arising from varying powers of absorption in health; in disordered conditions of the intestine, when absorptive capacity is impaired, these difficulties are infinitely increased. The attempts which have been made to compute the amount of bacterial life in the intestine by the quantity of products such as indol, skatol, &c., have been unsuccessful inasmuch as absorption remains an unknown quantity. It has, besides, been shown that while *B. coli communis* is, perhaps invariably, an active source of indol, many putrescent anaerobes, although present in large numbers and proliferating freely, produce no indol or skatol. A further illustration of the influence of absorption is seen in the fact that whereas in health the ingestion of carbohydrate food checks bacterial growth in the intestine by the formation of germicide acids of fermentation, in Sprue, and in other conditions where there is an excess of unmetabolized and unabsorbable residue, the result is exactly the opposite. In the meantime, conclusions as to microbic growth in the alimentary canal are more safely based on clinical evidence, on the condition of the patient, and on the character of the excreta, than on any of the methods that have been devised to obtain accurate knowledge of its extent and virulence.

CHAPTER XIX.

THE TREATMENT OF SPRUE BY DRUGS (*continued*).

SPECIFIC REMEDIES.

APART from the characteristic antagonism to the disease processes of Sprue which is exhibited by strawberries, bael, and other fruits, it is asserted that various pharmaceutical remedies possess similar curative virtues. The use of some of them, such as santonin, originally introduced as an anthelmintic, is advocated on frankly empirical grounds, but it is endorsed by a certain amount of scientific opinion; others, like pilocarpine, phosphate of lime, and sea-salt, prescribed in the first instance to meet some special indication, were adopted as specific "cures" on account of the definite remedial influence which they were supposed to exercise; while a few—mostly claimed as proprietary by their vendors—are mere concoctions of native nostrums dispensed in European fashion.

SANTONIN.—On the assumption that the disorder is invariably attended, if not actually caused, by intestinal entozoa, anthelmintics have figured largely as specific remedies for Sprue. The regular use of santonin, originally proposed as a routine treatment by Colin[1] in 1878, was naturally adopted by many French physicians, who believed with NORMAND and GERVAIS that the minute worm discovered by the latter observers was the pathogenic agent of the

[1] *Gazette hebdomadaire*, 1878, p. 133.

disease; but after it was shown by LE BRÉTON and CHASTAING that the presence of anguillula had no causative connection with Sprue, santonin and other anthelmintics passed into disuse, and appear to have been practically abandoned. Some time afterwards, however, Dr. CHARLES BEGG, of Hankow, commenced to treat his patients by regular doses of crude yellow santonin and found it to be a satisfactory remedy. Without special diet, or other than ordinary precautions, he claimed that Sprue could be speedily and permanently cured by this method alone. The drug was believed to be efficacious as a specific rather than as an anthelmintic remedy; at all events, success was not supposed to be attained by the expulsion of the grosser entozoa. In a letter to *The Lancet*[2] Dr. BEGG said that a considerable experience of Sprue in China and in England had confirmed him in his conclusions that refined white santonin was useless, but that, in a large number of cases treated by the yellow drug, he had not had a single failure. Such a definite statement certainly merits careful consideration, yet Dr. BEGG'S views have, so far, received little if any support or corroboration.

The anthelmintic properties of santonin may, of course, be useful in certain cases, and when ascarides or other entozoa are present the repeated use of the drug is necessary. Moreover, patients who are treated by santonin in combination with a special diet naturally do well; but after a careful and somewhat extensive trial of yellow santonin in undoubted instances of Sprue, my own experience is that without special diet it has no influence in modifying the symptoms or the course of the disorder, and that it is, in fact, of no value as a specific remedy.

PILOCARPINE.—Originally prescribed by FÉRIS in Cochin China

[2] *The Lancet*, January, 15 1898

to stimulate the salivary secretion, and, thereby, to increase carbohydrate digestion in certain cases of Sprue, pilocarpine was considered by him to exercise, besides, a definite specific effect on the disease.

In an article[3] published in 1885, in which he advocated its adoption as a remedy, FÉRIS stated that by the systematic use of pilocarpine he had obtained excellent results in the general treatment of Sprue, and that he believed they were due to the alteration or "therapeutic diversion" set up in the intestinal juices by the drug. That pilocarpine and jaborandi had a marked action on the biliary, the pancreatic, and, especially, on the mucous secretions of the intestine was well known, and that the course of Sprue might be altered by the exhibition of these drugs was considered probable. The treatment was generally adopted in the French Naval Hospitals and was at first apparently successful; but, after further trial, the conclusion was reached that, although pilocarpine alleviated the urgency of the symptoms and checked the diarrhœa, it had no permanent beneficial effect on the condition of the patient, or on the progress of the disease. The scanty saliva became more abundant, clear, and alkaline, while there was, occasionally, marked improvement in the general condition, and in the colour and character of the dejecta; but, with continued administration, the effect of the remedy soon became exhausted, and things were worse than before. It is doubtful, however, whether pilocarpine deserved either the vigorous condemnation or the excess of praise which it received from the French physicians. Although it has no specific effect on the course of Sprue, pilocarpine should be borne in mind as a drug that may be of distinct value in certain cases. Apart from the relief which it affords to special symptoms

[3] *Archives de Médecine navale*, 1885.

such as anidrosis and defective salivary secretion, pilocarpine has a marked influence in alleviating the pain of myalgia, and in counteracting the malaise and fatigue which are incidental to the progress of the disease.

PHOSPHATE OF LIME.—In the Tropics, the salts of lime have been much used as remedies for chronic diarrhœa. In the treatment of Sprue, the carbonate and phosphate are favourite native medicines, and are said to effect improvement in the general condition by liquefying the viscid mucus which coats the intestine. As a general rule, the salts of lime are free from the disqualifications which attach to astringents, and the Mistura cretæ of the pharmacopœia often acts as a simple and effective remedy for intercurrent attacks of acute diarrhœa. By its timely use the necessity for opium may in many cases be avoided. The phosphate of lime is also a valuable antacid, and, like the lactate, possesses considerable efficacy when prescribed with dietetic treatment. The white decoction of Sydenham, of which our Mistura cretæ is a modification, is still in regular use in the French Service Hospitals in the East, and it is noteworthy that, according to the original formula, the phosphate of calcium is the principal ingredient of this excellent preparation.

SALT AND CHLORIDE OF SODIUM.—Sailors have always attributed curative virtues of a high order to sea-water, and in the Eastern Tropics it has long been reputed an effective remedy for Sprue. The credit of salt water is not, however, based on popular belief only; it has, besides, secured a certain measure of professional approval, and many of the statements which have been made from time to time by competent French authorities as to the efficacy of chloride of sodium in the treatment of Sprue are certainly very remarkable. In reporting their investigations on the use of salt as a remedy, MM. CARRE and LENOIR many years ago stated[4] that

[4] *Thèse de Paris*, 1873 ("Du Chlorure de Sodium").

it had invariably given good results, and that it was sometimes surprisingly efficacious in Sprue. They record the case of a sailor who had been admitted to the Naval Hospital at Toulon in an advanced stage of the disease, and who was apparently dying from diarrhœa, profound anæmia, and exhaustion. He was ordered as much common salt as he could take, his sole food being raw beef, strongly salted. On this diet he made a complete and rapid recovery. Dr. THOMAS, under whose care the patient was, having been removed from the charge of the Naval Medical School at Toulon to that of Rochefort, continued, at the latter hospital, the same method of treatment for his Sprue cases, and his results were no less remarkable. His usual plan was to give half an ounce of sea-salt daily, with a full diet of uncooked salt beef; and on this *régime* he found that the dejecta quickly became normal, the body-weight increased, and convalescence was speedily established. MM. BERTRAND and FONTAN,[5] who are, in general, somewhat cautious and chary of approval for new methods, adopted this system of treatment, and record their authoritative testimony that they never had occasion to regret having tried it.

In view of these definite statements, it is somewhat surprising that there are few, if any, reports as to the efficacy of chloride of sodium from other than French sources. Personally, I have some experience of this method, and although it is difficult to estimate the exact effect exercised by the salt, when diet is restricted to raw meat, it may fairly be said that cases treated in this way did at least as well as those on meat alone. One patient, however, for whom a diet of salted milk—similar to that which was formerly in vogue as a treatment for phthisis—was prescribed, did badly, and the food had to be changed; but it is possible that in other instances the event would have been more satisfactory.

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[5] Bertrand and Fontan: *L'Enterocolite endémique des Pays chauds*, p. 389.

When salted or cured meat, such as bacon, ham, corned beef, dried or smoked fish, is taken as part of the mixed diet which is allowed to a Sprue patient during convalescence, it disagrees so frequently that it is questionable whether preserved food should ever be sanctioned even after complete recovery. As an exclusive diet, however, the effect is entirely different; but although salt and salt meat may be given in that way without detriment, and often, as has been seen, with marked advantage, there can be no doubt that fresh food, such as milk and fruit, forms the best nutriment for the great majority of cases of Sprue.

ARGILLA—finely powdered desiccated white clay—has recently been introduced on the Continent as a remedy for the diarrhœa which originates in excessive fermentation and intestinal sepsis. Goerner[6] states that the inhibitory action of powdered clay is a mechanical one, and that the finely divided particles directly arrest bacterial growth. In acute diarrhœa with meteorism, Strumpf found that argilla in suspension in water quickly relieved the symptoms; and in at least one case of Sprue the results have been equally satisfactory. The doses are large; 100-200 grammes (three to six ounces) of argilla are stirred up with half a pint of water, and the whole quantity is taken at short intervals during the day. The patient should fast; and on no account should any milk or sugar be taken within four hours of the argilla. A usual dose for children —argilla is said to be an excellent remedy for cholera infantum—is half an ounce. From the reports that have already been published, it is evident that this method has been highly successful in the treatment of septic and fermentative diarrhœa in Europe; it appears to be thoroughly effective, and it does not produce constipation or loss of appetite. The remedy is, moreover, inexpensive and

[6] *Münchener med. Wochenschrift*, November, 1907.

convenient, and it keeps well in any part of the world. Although more information is required as to this and other less familiar methods of treatment, it would seem to be the case that the possibilities of argilla in Sprue as an intestinal germicide are very considerable. It may be that there has been a tendency to keep too much in dietetic grooves, and that further experimental work with similar remedies may produce even better results.

NATIVE AND PROPRIETARY SPECIFIC REMEDIES FOR SPRUE.—Many nostrums are widely advertised in the Eastern Tropics as infallible remedies for Sprue and Dysentery. In most cases these are modifications of native formulæ, and are generally composed of powdered crabs' eyes, cuttle-fish bone, dried mangosteen rind, Chinese cinnamon bark, gambir, simaruba, and other indigenous products. A few are based on the prescriptions of Western pharmacy, and contain, as a rule, opium, logwood, eucalyptus, catechu or other astringents. Though they may temporarily check an attack of diarrhœa, the latter, if taken for any length of time, are, of course, highly prejudicial. The native remedies are more innocuous, and, when given with dietetic precautions, seem, in some cases, to do good. As with other drugs, however, it is difficult to estimate their exact value. In one instance which recently came under observation a patient, a man of high intelligence and education, assured me that he and several of his friends, who had suffered much at the hands of regular physicians, had been cured of Sprue by a preparation in which he placed great confidence. The prescribed treatment was half an ounce of Italian castor oil every third day, and a teaspoonful of a white powder morning and evening on intervening days. The diet was limited to soups and fish. No carbohydrate was allowed. The remedy, when examined, was found to consist of carbonate of lime and a trace of organic matter; it had, apparently, been prepared from powdered oyster-shells.

Obviously, in these cases, the effective part of the cure is dietetic, and although the attention of the patient is directed to some drug as the important factor, it is either inert, or, at most, exerts but a feeble influence on the course of the disease.

EUPEPTICS AND RESTORATIVES.

NATURALLY, an infinite variety of eupeptic and tonic restoratives have been given to counteract the indigestion and marasmus of Sprue. Ferments, such as pepsine, pancreatine and maltine, are recommended by some authorities, while stomachics, like damiana, kola, quassia, simaruba, coto and paracoto bark, are praised by others. It is possible that these remedies may assist or stimulate flagging digestive capacity, and that, in certain instances, they may thus be of benefit, but they are of no avail in arresting or materially ameliorating the progress of the disease. PEPSINE and PANCREATINE, especially the latter, have been the subject of very careful clinical research at the hands of French physicians, and MM. BERTRAND and FONTAN[7] strenuously advocate their routine use in Sprue. They assert that in every case in which milk cannot be borne, tolerance may be established, and the clots of hard curd in the intestine rendered assimilable by the use of these ferments. They recommend pills, each containing 3 or 4 grains of pancreatine made up with honey, and coated with hard wax, as the best form in which to give the latter remedy. M. FERIS says[8] of pancreatine that it acts not so much as a digestive ferment as by stimulating into effective action the glands to whose function it corresponds. Doubtless, in special cases, and in certain complications, these

[7] *Loc. cit.*, pp. 393, &c.

[8] *Thèse de Paris;* quoted by Bertrand and Fontan, p. 395.

ferments may be of service, and, as indigestion is generally intestinal, pancreatine would seem to be indicated rather than pepsine, but, as a rule, they are unnecessary, and their proper *role* in the treatment of Sprue is to be kept in reserve and used only should occasion arise. As diastase digests starch only, there can be no justification for the use of maltine as a ferment when carbohydrate food is excluded from the diet, although it may supply a limited amount of nourishment in an easily digestible form. Of the vegetable bitters, DAMIANA and KOLA have been given with considerable advantage in certain instances in which restoratives were indicated; while QUASSIA and SIMARUBA have also acquired some reputation in the general treatment of Sprue. Probably the latter drug is the more effective: it is the root bark of the Mountain Damson (*Simaruba officinalis*, West Indies), and is a popular and accredited remedy for dysentery and diarrhœa throughout the Tropics. The infusion, freshly made, which is the best form in which to give simaruba, is prepared by infusing half an ounce of bruised root bark for fifteen minutes in a pint of boiling water. Two to four ounces are taken every three hours. The infusion may also be employed as a rectal injection.

In certain cases of Sprue, as in chronic dysentery, simaruba has undoubtedly given excellent results when employed as a general tonic and restorative, but in the ordinary type of the disorder, when there are no acute dysenteric symptoms, it has no beneficial action. Patients, however, like the bitter and somewhat astringent taste of the drug, and as there is a general belief that it assists dietetic measures, simaruba often forms a useful and acceptable placebo to those who insist on the aid of pharmacy.

COTOIN, an alkaloid prepared from the bark of the coto-tree—which is indigenous in Bolivia—is extensively used in the French and Dutch tropical Colonies as a remedy for diarrhœa due to

derangement of intestinal function. It is said[9] that cotoin reaches the duodenum unchanged, but, being soluble in bile, it is dissolved there, and it then acts as a powerful restorative and antiseptic. Careful trial of this alkaloid—which is of undoubted value in the diarrhœa of phthisis, malaria, and other toxæmic conditions—has, however, failed to recommend it to English physicians as having any definite curative action in Sprue. In some cases it appears to check fermentation and to relieve the discomfort incident to it; and it may thus be regarded as one of the many drugs which may occasionally be of service. Cotoin is best given in 2 or 3-grain doses in a weak solution of gum arabic (Albertoni).

[9] Bouchardat, *Annuaire de Thérapeutique*, 1884.

CHAPTER XX.

The Treatment of Complications and Collateral Infections.

Acute Diarrhœa.

Untreated Sprue, as a rule, is slowly progressive, and the fatal issue is due to toxæmia and exhaustion. Intestinal flux, although a prominent symptom throughout, is seldom the direct and determinant cause of death; but, as has been seen, in a considerable number of instances intercurrent attacks of diarrhœa intervene during the course of the disease. Occasionally they are choleriform in character and are rapidly followed by collapse. Such seizures are the most dangerous complications which arise in the course of Sprue, and treatment, to be effective, must necessarily be immediate. But in the great majority of cases the attacks are much less serious; diarrhœa, although acute, is seldom so severe as to be alarming, and milder measures are generally sufficient to tide the patient over what may be, after all, but a passing derangement.

The grade of severity which a seizure will assume can, however, never be foretold, and it is imperative to treat all cases as if they might become dangerous. When acute diarrhœa sets in during the progress of Sprue, the patient, if not already laid up, should be confined to bed and a careful examination of the abdomen should be made. General or local tenderness, indicating diffused or

circumscribed inflammation, is almost invariably present; and, as a rule, the condition is local and obviously due to the retention of undigested food, milk clots, or other matter. In such cases, an ounce of castor oil, with ten minims of Tinct. opii, should be given at once, and after the irritation has been thus cleared away, a few doses of Mistura cretæ (one ounce every two hours) usually suffice to allay the pain and to establish regular action of the bowels. In ordinary circumstances no further treatment is required. If the inflammation is slight and unaccompanied by retention of the intestinal contents, castor oil is unnecessary, and the symptoms may be speedily alleviated by rest, restriction of diet, and Mistura cretæ.

When it is apparent that the attack is of a serious nature, more energetic measures are demanded. To relieve the abdominal pain, which simulates the cramp of cholera, and to prevent intestinal ulceration, which is in most cases imminent, a counter-irritant and anodyne, such as the Lin. opii ammoniat.,[1] B.P.C., must be applied to the abdomen. A double thickness of lint is soaked in the liniment, fixed by a flannel bandage over the tender spots, and kept in position as long as it can be borne. No castor oil should be given, but if the lower bowel is blocked it must be cleared by a warm enema of soap and water. Opium is almost always necessary, and, unless there is vomiting, the preferable method of administration is by the mouth. Contrary to usual experience in other circumstances, opium given in this way checks the acute diarrhœa of Sprue more rapidly and more effectively than when

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[1] R. Tinct. opii
Lin. camph. co.
Lin. saponis ää ... ... ʒvi.
Lin. bellad. ... ... ʒi.
Liq. ammon. fort. ... ... ʒi.
Mix and filter.

it is used hypodermically, and the simpler preparations of the drug, such as Tinct. opii, Liq. opii sedativ. and Nepenthe, act more satisfactorily than Chlorodyne and other complicated tinctures. Fifteen minims of Tinct. opii, or ten of Liq. opii sedativ., should be given at once, repeated, if necessary, in an hour, and continued in smaller doses—five or ten minims—at longer or shorter intervals, as may be required. A demulcent enema of Starch and Tinct. opii, or of solution of gum arabic, is often useful, and counter-irritation may also be increased and accelerated by turpentine stupes. Ice-bags are harmful. It is advisable to discontinue opiates as soon as they have taken effect; and they should not be readministered unless absolutely necessary. The food must be limited to the smallest possible quantity; if the patient is already on a milk or meat diet, it should be stopped, and albumen water or raw beef juice substituted. As there is usually great thirst, the former is preferable; it may be readily prepared by thoroughly mixing the albumen of one egg with twice its volume of water, and straining the solution through muslin. With discrimination, albumen water may be taken *ad libitum*. As a rule, no other food or medicine is necessary, and, on the cessation of diarrhœa, peptonised milk may be given or special diet may be resumed.

In exceptional cases, diarrhœa is of such severity that collapse ensues, and the patient falls into an algid condition, with a marked tendency to syncope. In these circumstances, a hypodermic injection of Strychnia should be given at once (five minims of a 1 per cent. solution of Strychnine hydrochloride in sterilised water), while an intravenous or subcutaneous injection of normal saline solution is being prepared. Half an ounce of brandy with two and a half ounces of hot water should at the same time be passed into the stomach by a tube or soft catheter, the patient's body being wrapped in a blanket and the extremities vigorously massaged

and centripetally rubbed. Hot-water bottles are harmful in the Tropics, but in colder climates they may be useful.

In most countries where cholera is endemic, physicians carry with them solubes, or tablets, for making normal saline, but in their absence a solution fairly isotonic with the blood corpuscles may be quickly prepared by dissolving a teaspoonful of common salt in a pint of boiled water. Of this a pint or more should be injected at a temperature of 105° F., by slow pressure from an irrigator into the median basilic vein; or into the subcutaneous tissue below the right clavicle. During collapse, such an injection is absorbed from the areolar spaces with astonishing rapidity, and as much as four pints (two under each clavicle) may be injected with the best results.

Dysenteric Diarrhœa.

Attacks of dysenteric diarrhœa (*crises dysentériques*) are, as has been seen, more frequent in certain districts and in certain circumstances than in others, but as a rule they originate in the same way as the seizures of acute diarrhœa. Except for the important fact that the discharges are dysenteric and not choleraic in character, there would be little to differentiate these complications of sprue from each other, and although *crises dysentériques* are, in the great majority of cases, undoubted instances of true dysenteric infection, the treatment is much the same. Dysenteric diarrhœa is, however, milder in character and more amenable to remedial measures than choleraic flux, and it seldom or never terminates in the collapse and algidity which are associated with the latter type. After a preliminary purge the pain and spasm of the *crises dysentériques* must be counteracted by hot stupes, or by applications of Lin. opii ammoniat., and, provided that there is no retention of fæces, opium may be given as readily as when

the dejecta are free from blood. If the action of the initial dose of castor oil has been satisfactory, and if nourishment is then limited to small quantities of albumen water, raw beef-juice, or peptonised milk until the crisis has passed, the free use of opium in this form of dysentery need cause no apprehension of fresh irritation from retained dejecta.

Ipecacuanha is generally an unsatisfactory remedy; it induces violent sickness, and seldom alleviates the urgency of the diarrhœa or the distress which is incident to the purging. On the other hand, Infusion of Simaruba may be useful; it should be prepared as already described, and it may be given both by the mouth and as a rectal injection. Marked amelioration of all the symptoms, and especially of intestinal hæmorrhage, generally follows the use of simaruba, and a considerable experience of its action in the dysenteric diarrhœa of Sprue confirms the estimation in which this remedy is held both in the Eastern and Western Tropics. Simaruba is officially recognised in the Dutch, French, Mexican, Portuguese and Spanish Pharmacopœias, but not in the British.

Demulcent enemata of starch and opium are also useful, but in acute attacks parasiticide and antiseptic injections, such as nitrate of silver, iodised water, and salicylic acid, should never be ordered.

HÆMORRHAGE.

Hæmorrhage from the bowel may be so urgent as to demand immediate treatment, and its onset is often insidious and unanticipated. Although intestinal bleeding is very rare in the ordinary course of Sprue, there are few cases in which ulceration does not somewhere involve a moderately large blood-vessel, and hæmorrhage may come on without an acute dysenteric attack, or other

intimation of serious tissue destruction. It may also take place without the passage of blood *per rectum*.

When dangerous bleeding occurs the patient should be kept at absolute rest in bed, a large dose of morphia should be injected hypodermically, and all nourishment except sips of ice-water should be withheld. Fifteen minims of Adrenalin chloride solution (1 in 1,000) should at the same time be given by the mouth, and repeated in half an hour. If collapse supervenes, resort must be had to ether and strychnia, and a normal saline injection should be prepared.

METEORISM.

Tympanitis and meteorismus are frequently seen in the advanced stages of malignant Sprue, and their occurrence must always be regarded as of very serious omen. They are indicative of the partial or complete cessation of digestive function, and, as a rule, little can be done for patients in whom they are marked symptoms. Certain remedies, however, occasionally seem to be of service in relieving the distress incident to the flatulent distension of the intestine. Turpentine may be given internally, in ten minim doses, and applied externally to the abdomen on hot stupes. In the East Indies, Asafœtida—preferably the fresh gum, which can be obtained in most bazaars—is a favourite remedy for tympanitis, and is often surprisingly efficacious after the graver symptoms of meteorism have developed. When the fresh gum is not procurable, Pil. asafœtidæ co., or Pil. galbani co., are useful substitutes, and these drugs should have a place in every tropical dispensary. Small doses are useless, and at least ten grains of the gum every four hours are necessary to produce any effect. Free Chlorine may also be given, and wood-charcoal is recommended, but neither is of much service. A rectal tube seldom reaches the

flatus; and although puncture of the intestine has occasionally succeeded in desperate cases, it is a dangerous procedure, and should not be undertaken lightly. A copious enema of warm saline solution often relieves intestinal distension, and revives and invigorates the patient. When it is administered, a stimulant—one and a half ounces of brandy with five ounces of water—should be given. With the free use of asafœtida internally, saline injections are, as a rule, the best general treatment for tympanitic conditions in Sprue.

HICCOUGH.

Persistent hiccough may often be relieved by an ounce of the following mixture, repeated every hour :—

℞ Liq. trinitrini (1 per cent.) ... mviii.
Sp. chlorof. ... ... ʒiv.
Aq. dest. ... ... ad. ʒiv. Misce.

PANCREATITIS.

There can be but little doubt that pancreatitis, of a more or less severe type, is not only a frequent but a usual complication of Sprue, and that it persists in a chronic form after the mucosa of the intestine has been restored to the normal condition. There is also reason to believe, as Dr. C. BEGG has suggested,[1] that the connection between pancreatitis and Sprue is more than accidental—a point to which reference has already been made in the chapter on diagnosis—and that, if a careful examination of the urine is made for Cammidge's reaction, the pancreas will be found to be at least functionally involved in all cases of Sprue. In

[1] *Proceedings of the British Medical Association, Section of Tropical Diseases*, 1907.

ordinary circumstances, no treatment is required, and beyond the continuance of dietetic measures, with, perhaps, the administration of pancreatic ferments, and of pancreatised food, little can be done for the condition. Symptoms, such as pain or vomiting, may be treated, but counter-irritants do harm. If there is reason to suspect tension from hæmorrhage or from the formation of pus, laparotomy should be performed; and such other measures as may be found necessary when the abdomen is opened must then be adopted.

Myalgia.

As has been seen, severe myalgia is almost invariable in Sprue. It remains long after apparent recovery; and, in cold climates, where the aching is usually attributed to rheumatism, myalgia is especially troublesome and persistent. In most cases muscular pain can be effectively relieved by the use of pilocarpine and massage. For regular administration, Nitrate of Pilocarpine is the most suitable salt of the alkaloid. Preferably it is given by the mouth, in tablets of $\frac{1}{10}$ to $\frac{1}{8}$ grain, one, three times daily. General massage for half an hour every second day should also be ordered, with a further ten minutes localised rubbing to the groups of muscles which are specially affected. Under this treatment, wasted and flabby muscles quickly regain their condition and tone, and the pain is generally much relieved. When the patient is strong enough, he should at the same time have a Turkish bath twice weekly.

Insomnia.

Sleeplessness is unusual in Sprue, but it is occasionally a prominent symptom, and it may give rise to much distress. The condition is generally one of restlessness and high nervous

tension, with vague and groundless apprehension, needless worry about trifles, and unnecessary anxiety about business and financial matters. Melancholia is, however, very rare, and mental acuteness is unimpaired.

The treatment of these cases is often difficult. Stimulants are generally demanded, and they invariably relieve the symptoms; but the effect is only temporary, and, as increasing quantities are required, it is unwise to begin them. Abstinence should be insisted on from the first, and in no circumstances should the importunity of the patient for alcohol be regarded.

Opium is the only sedative which will soothe without further depression; but it is a most valuable remedy, and the judicious use of the drug is followed by very great improvement in the mental and physical condition of the patient. In such cases bromides and synthetic soporifics should never be allowed; and small doses of Dover's powder, or of nepenthe, are preferable to all other hypnotics.

Helminthiasis in Sprue.

When the microscopical examination of the dejecta has demonstrated a collateral infection of entozoa, an anthelmintic is necessary. To effect the expulsion of ascarides, Santonin is a sufficient and harmless remedy; five grains are given before dietetic treatment, and repeated when advisable. Ascarides are, however, harboured by Sprue patients much less frequently than strongyloids and anchylostomes, and against both the latter varieties of parasites, santonin is ineffective. The question of the treatment of these infections is of great importance, as, in ordinary circumstances, the anthelmintic in general use is Thymol, and that drug should never be given. In the doses in which it is neces-

sarily administered to expel entozoa, thymol irritates the inflamed and abraded mucosa, and—a still more serious disqualification—it is frequently absorbed in such quantities as to induce specific intoxication. Unless the intestine is healthy, thymol is dangerous, and it is always inadmissible in Sprue. Beta-naphthol, which is recommended by Bentley and others as a harmless substitute for thymol, is not altogether free from a similar objection, and the only anthelmintics that may safely be sanctioned are Eucalyptus Oil and Pomegranate Root. The following is the usual formula for the administration of eucalyptus :—

℞ Ol. eucalypti ... ... mxv.
Chloroform pur. ... ... mxx.
Ol. ricini ... ... ʒvi. Misce.

This draught is ordered to be given in the morning, and before any food has been taken.

In ordinary circumstances, and in the case of severe infections, it is usually advisable to repeat the remedy at frequent intervals, but it is seldom necessary to do so in Sprue. Although the chloroform appears to be essential for anthelmintic purposes, the dose is unusually large, and the effect of the draught must be closely watched.

Infusion of the fresh bark of pomegranate root is effective against strongyloids and anchylostomes, and it has no unfavourable local or constitutional action in Sprue. The tree grows freely in the Eastern Tropics, and there is usually little difficulty in obtaining fresh root. Two ounces of the finer rootlets are dug up, lightly washed, and bruised in a mortar; a pint of boiling water is thereupon poured over the twigs, and after they have been well stirred, the infusion is allowed to cool, and strained through fine muslin; pure chloroform, in the proportion of 1 minim for each ounce, is then added, and the remedy is ready for use. Before

administration an ounce of castor oil is given to clear away the mucus with which the worms surround themselves, and after it has acted—the patient having fasted meanwhile—ten ounces of the infusion are taken. An hour afterwards a pint of clear soup, bovril, or mutton broth may be given, and four hours later the remaining ten ounces of infusion. Pomegranate root bark, when it can be obtained fresh, is by far the best and safest anthelmintic for general use in the Tropics; it is thoroughly effective, and seldom or never gives rise to unfavourable symptoms. The dried root and the alkaloid pelletierine are unreliable.

Acute Fæcal Impaction in the Rectum.

During the treatment of Sprue by diets of which milk forms a principal part, it sometimes happens that the glutinous residue obstructs and distends the rectum to such an extent that the expulsive muscles are unable to effect a natural clearance of the bowel. The impaction—in such cases termed acute, to distinguish it from the scybalous stoppages of old age and chronic constipation—originates in causes that are purely mechanical. As has been seen, the dejecta resulting from a milk diet in Sprue are of exceptional bulk and tenacity, cohesion being sometimes very extreme, and it is not surprising that the efforts of the patient occasionally prove unequal to remove the encumbrance.

The presence of an impacted mass is indicated by a feeling of discomfort, and by a preliminary stoppage of the action of the bowels with subsequent diarrhœa and straining. The latter symptom ought at once to arouse suspicion, and in every case in which there is tenesmus a careful examination should be made. In such instances the rectum is generally found to be distended by a globular and almost incompressible mass; and, if the condition is of some standing, the mucosa is catarrhal and perhaps ulcerated.

Unless there is much inflammation, removal is easy; the impacted fæces may be broken up mechanically, without pain, and a copious soap and water enema is then sufficient to clear away the rest of the obstruction.

The condition is apt to recur, and prevention is important. When impaction has once occurred, half an ounce of castor oil should be taken by the mouth daily so long as milk is the preponderating constituent of the food; in some cases a change to a meat diet may be necessary, but as a general rule, the laxative is sufficient. It is stated[1] by a recent writer that rectal obstruction indicates an insufficiency of fluid in the diet, and that it may be prevented by dilution of the food and by the administration of water, lemonade, &c. This explanation of impaction is not convincing; the quantity of water supplied to a patient on a milk diet is much in excess of his requirements, and further dilution, as is well known, increases rather than diminishes the tendency to constipation. On the other hand, a small quantity of castor oil appears to increase the mucous secretion of the intestine and to prevent the excessive dryness which characterises the residue of a milk diet. When strawberries or other fresh fruit can be obtained in sufficient quantity, castor oil will seldom be necessary, and the addition of fruit to the food is generally the best preventive of impaction.

[1] Robson, *British Medical Journal*, 1908, p. 1041.

CHAPTER XXI.

LOCAL MEDICATION IN SPRUE.

STOMATITIS.

DURING the whole course of Sprue the condition of the MOUTH and TONGUE requires careful and continued attention. So soon as the presence of the disorder is ascertained, or even definitely suspected, special attention must be given to the hygiene of the mouth. Unless irritation is excessive, the teeth should be thoroughly cleansed twice daily by a soft badger-hair brush, and the mouth afterwards washed out with a weak solution of Listerine (Lambert)—half a teaspoonful to a glass of water. Immediately after food, the whole of the buccal cavity—mouth, teeth and pharynx—should be rinsed by a solution of borax in glycerine and water, or by a lotion of hydrogen peroxide, or, when it can be borne, by a stronger alkaline gargle. Suitable formulæ are as follows :—

℞ Boracis ... ... ʒii.
Glycerini ... ... ʒi.
Aq. ... ... ad ℥xii.
Misce.

℞ Liq. hydrogenii peroxidi P.B. ... ... ʒii.ss.
Aq. ... ... ad ℥xii.
Misce.

℞ Sodii bicarb. ... ... ℥ss.
Boracis ... ... ʒi.
Aq. ... ... ad ℥xii.
Misce.

Should the inflammation and irritation be too great to admit of the use of these remedies, the mouth may he washed three or four times daily with warm water to which a little common salt (ʒi.ss to Oi.) has been added.

When, as frequently happens, the patient is at the same time suffering from Rigg's disease, the continual flow of septic pus into the mouth not only keeps up the local irritation, but is highly prejudical to the general health. For this condition special treatment by inter-alveolar injections is desirable, and the services of a dental surgeon are required. Carious teeth should, of course, be filled, and dead roots extracted. In such cases antiseptic lotions are always necessary, but in Sprue many of the dentifrices and germicide mouth-washes in common use give unsatisfactory results, and greatly increase the irritation and discomfort.

Corrosive sublimate and mercurial washes should never be used ; carbolic acid and creosote harden and devitalise the epithelial structures ; while solutions of the essential oils, though sometimes effective, are less suitable for local than for internal disinfection. As a rule, most reliance will be placed on hydrogen peroxide and alkalines. A convenient method of obtaining the antiseptic action of hydrogen peroxide in an extremely effective and unirritating form is by the use of magnesium peroxide. This salt breaks up in the mouth into magnesium chloride and peroxide of hydrogen, the latter compound being again deoxidised into water, and nascent oxygen being set free. Half to one teaspoonful of magnesium peroxide is stirred up in a tumblerful of water, and used as a mouth-wash. Vesicles and blebs should be pricked, and touched with glycerine and borax.

The aphthous and ulcerated patches of Sprue are exquisitely sensitive and tender, and it is generally necessary to brush them over with a solution of cocaine (10 grains to an ounce of distilled

water) two or three times daily; they may then be lightly swabbed with liq. hydrogenii peroxidi P.B. (1 : 10), or pencilled by a weak solution of nitrate of silver (½ to 1 per cent.). If pain and irritation persist after this treatment, ulcers and fissures should be carefully touched with solid nitrate of silver fused on a probe, after a preliminary application of cocaine of double strength (20 grains to 1 ounce).

In cases where there is a tendency to fœtor and heavy breath, a solution of salol, or of 1 per cent. of lysoform, freshly prepared, may be used as a mouth-wash. A convenient formula for a permanent salol dentifrice and mouth-wash suitable for sprue patients is as follows:—

℞ Salol ... ... ʒiiss.
Saccharin... ... ... grs. vi.
Ol. menth pip. ... ... ♏xxiv.
Dissolve in alcohol (80 per cent.) ʒxii. and add—
Ol. carui ... ... ♏ii.
Ol. anisi ... ... ♏ii.
Sig.—A teaspoonful to be used in a tumblerful of water.

When the mouth is much inflamed, or when there are raw patches, sores or ulcers, smoking should be discontinued.

ŒSOPHAGITIS.

The distressing spasm and severe pain which result from acute inflammation of the œsophagus are best treated by small doses of Adrenalin. When there is dysphagia five to ten drops of a 1 in 1,000 solution every four hours generally give prompt and permanent relief. In less severe cases, Liq. morphiæ acetatis with Sodii bicarb. may prove useful, but for the alleviation of œsophagitis reliance must chiefly be placed on dietetic measures, and, unless the condition is accompanied by acute pain and dysphagia, active treatment is unnecessary.

Chlorate of potash should not be given, and demulcents are of little use. The food must, of course, be bland and unirritating; and when œsophagitis is a prominent symptom of Sprue, a milk diet is preferable to all others.

Eczema of the Nates and Peri-anal Inflammation.

Dermatitis, the result of acid diarrhœa, is highly resistant to treatment, and many of the remedies which are usually successful in similar conditions are ineffective against the eczema of Sprue. As a rule, soothing applications are of more avail than antiseptic and stimulating lotions. In every stage and condition of the eruption, the affected parts should be washed at least twice daily in a weak solution of potassium permanganate, and, after careful drying, talc or boracic acid should be freely applied. Swabs or pledgets of cotton-wool used in the process should be burned. When the patient is confined to bed, an emollient ointment of orthoform and zinc oxide is sometimes very effective. The buttocks are washed three or four times daily with a superfatted soap (Cook's Riviera Soap is satisfactory), and the following ointment is then smeared freely over the parts:—

℞ Orthoform ... ... grs. 40
Zinci oxidi ... ... grs. 120
Amyli... ... ... grs. 120
Paraff. molle... ... ... ad ℥i.
M. ft. ung.

If, after this treatment, irritation persists, fissures or foci of irritation should be carefully sought out; and if any are found an ointment of ichthyol (10 per cent.) may be substituted for the orthoform and zinc oxide. Should they still prove resistant, it may

be necessary to touch them, after cocainisation, with a Paquelin's cautery.

When the integuments are dry, red, and thickened, without active inflammation or discharge, ichthyol in the following form often proves effective :—

℞ Ichthyol ... ... 3ii.
Acid. pyrogallici ... ... grs. 20
P. amyli, zinci oxidi, lanolini et. vaselini ...āā 3v.
Ft. ung.

As in other types of eczema, cleanliness, rest and attention to the diet are essential to the cure of the condition. Alcohol is invariably contra-indicated ; while coffee, tea, and similar beverages are generally prejudicial.

Rectal Injections.

Rectal injections are seldom necessary in Sprue. Irrigation of the colon has been tried, but the results, as might be anticipated, are unsatisfactory. In ordinary circumstances, the disease process of Sprue is most active in a part of the intestine which is far beyond the reach of medicated injections, and little if any benefit can be expected from their employment. The only condition which demands their occasional use is catarrhal inflammation of the sigmoid flexure and rectum. Contrary to what is seen in dysenteric diarrhœa, proctitis is rare in Sprue ; but when it occurs a somewhat copious douche—15 to 20 ounces—of a 1 per cent. solution of argyrol is the best remedy. Irritation of the lower bowel often originates in excessive inspissation of the intestinal contents in the colon, and this should be prevented by the regular administration of castor oil. In Sprue, the rectal speculum should never be used.

Rectal Alimentation is frequently required in the graver

complications of Sprue. In many cases of choleriform seizure, the ingestion of the smallest quantity of food or liquid is followed by alarming vomiting, hiccough, meteorismus, and other symptoms of digestive paralysis, and in such instances alimentation must for the time be entirely rectal. Although there may have been severe diarrhœa, with, possibly, paralysis of the sphincter, it is a remarkable circumstance that in such conditions there is often surprising tolerance for nutrient enemata; and suitable food administered *per rectum* is not only retained without difficulty, but frequently proves of the greatest service at a very critical period.

The following points as to rectal feeding in Sprue are important :—

(1) The nourishment should be quite liquid, and as near the temperature of the body as possible.

(2) It should be pancreatised. Undigested meat extracts, soups, or beef tea, are useless.

(3) It should be slowly passed into the bowel, as high as possible, by a rubber tube from an irrigator, the pelvis of the patient being raised on a soft pillow.

(4) During and after the operation, the patient should be kept absolutely at rest, and on his back.

(5) Where there is evidence of retained dejecta in the rectum or sigmoid flexure, the bowel should be washed out by a preliminary injection of warm water without soap.

Suitable formulæ for nutrient enemata are :—

(1)

The yolks of two eggs;
Dextrose (pure), 1 ounce;
A pinch of salt (10 grains);
Pancreatised milk, 10 ounces (half a pint).

(2)

The yolk of one egg ;
An ounce of liquid peptones ;
Five drops of tincture of opium ;
A pinch of bicarbonate of soda ;
Half a pint of milk (pancreatised).

It must not be forgotten that in Sprue there is a tendency to disorganisation and softening of the intestinal coats, and the utmost care should be employed in the administration of nutrient enemata.

CHAPTER XXII.

Alcoholic and other Drinks in Sprue.

One of the most marked clinical features of Sprue is the unfavourable influence which is exercised by alcohol, both on the local lesions and on the general progress of the disease. Not only are the mouth sores aggravated disproportionately to the physical irritation which is caused by wine and spirits, but the constitutional symptoms are distinctly prejudiced by the habitual consumption of any of the different varieties of alcoholic drinks. There is, in fact, from the earliest to the latest stage of Sprue, a specific intolerance and antagonism to alcohol in any form. During the first period of the disorder, it invariably increases the discomfort and inflammation in the mouth and œsophagus. If a comparison is made between cases treated on non-alcoholic lines and cases in which stimulants are allowed, it will be found that even the smallest quantities render the mucous membrane more sensitive, irritable, and tender, the dyspepsia more urgent, the eructations more frequent, and the tendency to diarrhœa more pronounced. In the later stages of Sprue, treatment which proceeds unsatisfactorily, and which is continually interrupted by relapses while stimulants form part of the diet, is put on an entirely different basis when they are discontinued. Further, when taken in excess, or except by special advice, alcohol may at any time induce the gravest symptoms.

Malt liquors, wine, and spirits should therefore be absolutely

prohibited, and the interdict should run from the beginning of treatment until many months after convalescence. When one has to deal with a progressive, or, in other words, an ordinary case of Sprue, there ought to be no exception to this rule. In many instances the physician will, doubtless, be told that it is impossible for his patient to survive such a deprivation; that he is old, enfeebled, and habituated to the regular and moderate use of stimulants; but, if treatment is to be successful, there should be no compromise. In the first place, the effects—even on those long accustomed to drink moderately—of a complete and sudden stoppage of stimulants during the course of an intestinal disorder, such as Sprue, are much less severe than they are in ordinary health. Abstinence is seldom attended by anything more than discomfort, and serious complications are unknown. The duty of the physician is plain; the administration of alcohol in any form, and in any quantity is incompatible with the radical cure of progressive sprue, and all stimulants should be definitely forbidden.

The antagonism between alcohol and a process of repair and recuperation in Sprue is generally recognised as a first principle in treatment. It is laid down by almost every writer on intestinal disease of tropical origin that stimulants are unnecessary and harmful, and in this respect recent experience fully corroborates the views of the older authorities. The following quotation illustrates the remarkable agreement on this point which has long existed between English and French physicians. In criticising Sir Joseph Fayrer's views, Roux, than whom there is no sounder authority on the treatment of tropical diarrhœa, says :—[1]

"Fayrer insists on the importance of forbidding stimulants to patients suffering from diarrhœa. He permits them only in rare

[1] Roux : "Maladies des Pays Chauds," p. 183.

instances, and then only in the form of brandy largely diluted in Vichy water. I go further, and absolutely prohibit the use of alcohol under any circumstances whatever. . . . The first duty of the physician is to forbid, once and for all, the use of alcoholic stimulants and wine. Especially ought he to discountenance the use of so-called tonic wines, the effect of which is deplorable; and beer, too, must be strictly forbidden."

Although, personally, without bias as to principle, and although accustomed to order alcohol, even in considerable quantities, in other diseases, there is nothing about which I have become so certain as that Roux's simple and direct statement is a correct enunciation of the policy which is incumbent on everyone who undertakes the treatment of Sprue, and extended experience has served only to confirm me in this opinion.

The question arises: What, then, is a Sprue patient to drink? During treatment by a milk or milk and fruit diet, fluid is, if anything, already in excess, and no further liquid is required. When meat forms the exclusive food, considerable quantities of warm water, barley or toast water, and rice tea are necessary, and these are, perhaps, at all times, the most suitable drinks for Sprue patients. Aerated waters of excellent quality are now to be had in abundance at most places in the Tropics, but, as a rule, they should be avoided. Lemonade, tonic and soda waters, are especially harmful in the earlier and more acute stages; but, with convalescence, and when the patient is put on a mixed diet, some of the less gaseous table waters, such as St. Galmier or Apollinaris, may be taken with advantage. In the Tropics, unless the source of drinking water is absolutely beyond suspicion, it should always be boiled and filtered.

CHAPTER XXIII.

The Treatment of Hill Diarrhœa.

In the great majority of instances, the treatment of Hill diarrhœa presents few difficulties, and the disorder readily yields to simple remedies and ordinary precautions. It is, however, important to remember that an attack, although apparently insignificant at first, may rapidly become serious, and assume a choleraic or dysenteric type. Early and careful supervision is therefore always imperative. In the milder forms of seizure—those in which arrival at a Hill Station is followed by morning sickness and diarrhœa—little treatment is necessary. The patient should remain in bed, and be carefully protected from further cold. He should be clothed in flannel, and a wide bandage of the same material should be wound in two or three turns round the loins and abdomen. No solid food should be allowed at first. In Hill stations the milk supply is generally to be regarded with suspicion; and unless the quality is assured, it is inadvisable to order fresh milk. If, however, reliable milk can be obtained, it may be given alone or with equal quantities of soda water or apollinaris, in small sips, at intervals of half an hour. In the absence of fresh milk, any of the unsweetened varieties of condensed milk already described may be used as a substitute; and if none of these are procurable, the less palatable sweetened condensed milk may be employed. For the first day no other food should be given; and unless diarrhœa and pain are

urgent, or unless there, is a recurrence of the symptoms, medicines are seldom required. All alcoholic drinks must be stopped.

In cases of a somewhat more serious type, when the pain is acute and of a colicky character, and especially when diarrhœa is lienteric, an ounce of castor oil with fifteen minims of Liq. opii sedativ. should be given at once. If the pain and purging still continue, the opium should be repeated after four hours, in a 10-minim dose, with the addition of one drachm of Liq. hydrarg. perchloridi. The latter drug has an almost specific effect, and it is especially useful in those cases in which the dejecta have assumed the white colour characteristic of Hill diarrhœa. In most instances, unless there is obvious evidence of irritant accumulation in the intestines, castor oil and other aperients are unnecessary, and corrosive sublimate by itself quickly re-establishes the flow of bile, and allays intestinal congestion. So satisfactory is the action of mercurial salts that their administration is now the routine treatment for Hill diarrhœa at all stages and in all conditions of severity; and unless there are special indications for the use of other remedies no other drugs are necessary. In the case of children, Hydrarg. cum Creta is similarly useful; and, as a rule, Dover's powder and opiates on the one hand, and pepsin, ingluvin, &c., on the other, are seldom required.

Mercurial salts cannot, of course, be continued for more than a short time, and it is chiefly in the acute stages of the disease that they are indicated. Occasionally, too, they prove unsuitable for particular patients; and especially in the case of persons of East Indian birth mercury is apt, even when prescribed in the smallest quantities, to be followed by salivation. In such instances, salol in 8-grain doses, or calcium lactate in 5-grain doses, may be employed with advantage. In chronic cases of Hill diarrhœa a combination of Cupri sulph. with a little opium has proved very efficacious. The following formula may be used:—

℞ Cupri sulph. ... ... gr. ½.
Pulv. opii ... ... gr. ½.
Massæ paraffini ... ... grs. ii. Ft. pil.

Such a pill should be taken two or three times daily after food. In these doses, Sulphate of copper rarely produces any feeling of nausea or sickness, and its beneficial effect in cases of chronic tropical diarrhœa and dysentery of long standing is surprising. Without the sulphate of copper, or without the opium, the pill is of little service, so that it may safely be concluded that the efficacy of the remedy is not due to either drug by itself, but to their combination. Dilute Hydrochloric acid is also of some use in the treatment of chronic dyspeptic symptoms, but Bismuth, soda, and stomachics generally, are seldom helpful, and sometimes, as in Sprue, are actually harmful.

DIET is, naturally, of very great importance in the treatment of Hill diarrhœa. Little or no food, except milk, should be allowed for the first twenty-four hours, but on the second day the diet may be cautiously improved. Lightly cooked or raw eggs, clear soups, extract of meat, custard pudding, arrowroot, Benger's food, &c., may be given during the next two days, and if there are no further symptoms, chicken soup with rice—well known to Indian cooks as "pish-pash"—with a small quantity of stewed fruit or an uncooked banana, may also be allowed. Tea and coffee are generally harmful, but, as a rule, cocoa, if carefully made, is easily digested. When milk is available, a suitable dietary for an ordinary case of Hill diarrhœa at this stage is: For early breakfast, a large cup of cocoa made with milk. For breakfast, 9 a.m., ten ounces (half a pint) of milk with the yolks of two eggs beaten up in it; at 11.30 a.m. a cup of arrowroot or cornflour. For lunch, 1.30 p.m., chicken or other good soup with rice, custard pudding or stewed fruit. Afternoon, ten ounces of milk or cocoa. Evening, Benger's food, prepared with milk. Milk, if desired, during the night. In

the absence of reliable milk, light farinaceous food (which is tolerated much better in Hill diarrhœa than in Sprue), with an increased quantity of soup, may be substituted. As the condition improves, boiled eggs, minced chicken, and fresh fish if procurable, with maccaroni, toast, or plain biscuits, may be added to the dietary. Stimulants should not be allowed until the patient is able to take solid food.

On this treatment recovery is usually rapid and permanent; and meat, game, rice, boiled vegetables, bread, &c., may be given within four or five days. Caution is, however, necessary, and if there is any appearance of a relapse recourse must again be had to slops.

In chronic cases of Hill diarrhœa, an exclusive diet of lightly cooked meat, such as has been already described (p. 150), sometimes proves very efficient; and when the disorder has assumed the persistent and aggravated type so frequently seen in those who have had lengthened residence in the Hills, or who have been freely and repeatedly exposed to chills in the Tropics, absolute restriction to a meat diet is by far the most successful treatment. In such cases, the general management of chronic Hill diarrhœa is similar to that of Sprue; but in contrast to the latter disorder, a diet of flesh gives more satisfactory results than milk, or milk and fruit, and even at home it should be regarded as the first choice. A further point of difference is that Perchloride of mercury, which is inadmissible in Sprue, ought to be given regularly along with the meat diet, and continued as long as it may seem to be advisable.

In chronic Hill diarrhœa, change of climate is always advisable; and with proper precautions against chill, dry, cold and bracing atmospheric conditions are more suitable for such patients than moist and sheltered seaside resorts. Special care is necessary as to bathing, and cold baths, either in the Tropics or at home, must be permanently forbidden to those who have suffered from Hill diarrhœa.

CHAPTER XXIV.

The Hygiene and Prevention of Sprue.

Without further knowledge of the actual cause of Sprue, definite statements as to the hygiene and prevention of the disorder are unwarranted, and only general indications are possible. A considerable amount of information has, however, accumulated, and, although mostly negative, the ascertained facts as to the origin of the disease are instructive. Experience, for instance, does not endorse the belief that the prevalence of Sprue is due to defective hygiene. On the contrary, it is since modern methods of sanitation were introduced into Eastern cities that the rapid extension of the disorder has taken place; and although the hygienic condition of most of the strongholds of Sprue is still, from a European point of view, deplorable, it is infinitely superior to what it was when Sprue was unknown. For several years after the occupation of Cochin China by the French, Saigon was perhaps, of all European settlements in the East, the most notoriously unhealthy. Since that time the swamps which surrounded the town have been filled up, and efficient systems of drainage, water supply and conservancy have been established, with the result that the general health has been much improved. In Saigon itself, malarial fevers, cholera, and dysentery are now comparatively uncommon, while in Cholon and the adjoining settlements the rate of mortality from these and similar diseases has been very materially reduced; yet, on the endemic diarrhœa of the country, sanitary measures have had little

or no influence. In Cochin China, Sprue now affects a larger percentage of the resident European population than ever before. And Saigon is but an instance of what may with equal truth be said of other important centres of commerce—of Shanghai, Singapore, Penang, Batavia, Soerabaya and Samarang. In these cities, before the introduction of sanitary supervision, when surface wells formed the sole source of drinking water, and when but little attention was paid to the hygienic requirements of very large populations, Sprue was infrequent; and it is a remarkable fact that the extension of a disease which chiefly affects Europeans has been coincident with the introduction of scientific sanitation.

The prevalence of Sprue in the uplands and country districts, where, relatively to population, the incidence of the disorder is even greater than it is in the towns, is also significant; but these facts do not warrant the conclusion that the neglect of sanitary measures is in no way responsible for the spread of the disease. On the contrary, there is every reason to believe that, although it does not directly originate in insanitary conditions, Sprue finds a very congenial soil in places where drainage and the hygienic disposal of sewage are neglected. So far as is possible, therefore, in the Tropics as at home, the provision of a pure water supply, and the prevention of its pollution by night-soil or other contamination, is the first duty incumbent on those who are responsible for the general health, not only of cities, but also of villages, of mining camps, and of plantations.

The question as to how far habit with regard to food and drink contributes to the prevalence of Sprue involves considerations of tropical dietetics, which extend beyond the scope of the present enquiry, and it is impossible to do more than to glance briefly at dietetic causes which influence, or which are supposed to influence, the development of the disorder. It has been freely

asserted that Sprue invariably originates in EXCESS, either in eating or in drinking. That, however, is not the case; experience shows that the proportion of Europeans who live freely and even imprudently in the Tropics, and who afterwards become affected with Sprue, is not so great as the percentage incidence of the disorder on those whose habits of life are moderate and temperate. But it would, again, be dangerous to draw the inference that dietetic moderation is without avail, or that it tends to foster the development of Sprue. The explanation lies in the fact that, in the Tropics as at home, hearty eaters have sound digestions, and are thus able to resist an infection which finds a favourable nidus in queasy stomachs. It is undoubtedly the case that although Europeans as a race are exceptionally liable to Sprue, those of them who are naturally dyspeptic, anæmic, and nervous about their health furnish the largest proportion of patients.

True prophylaxis against Sprue depends on intelligent and not over-specialised attention to the general rules of health in the Tropics. Food, drinks, exercise, dress, house accommodation, all have their own importance, but it is an importance which may readily be exaggerated, and disorders of digestion are as apt to originate in over-studious attention to dietetic precautions as in their neglect.

It is true, at least, that Sprue does not arise in an excess of food. The day of systematic over-eating in the Tropics—if it ever existed beyond the limits of a small section of the European population—has disappeared; and the long periods of enforced idleness have given place to continuous commercial activity. The tendency is now in the opposite direction: meals are often insufficient, taken too hurriedly, and with too much cold liquid. In former days there was no Sprue, and although the absence of the disorder did not depend on excess, there is equal danger in both extremes. It

cannot be too clearly laid down that to preserve good health in the Tropics, Europeans—both men and women—require more exercise and as much food as they do at home. Again, several articles of diet which are in common use in hot climates have been incriminated as predisposing to Sprue. Thus, it is variously asserted that the disorder originates in a preponderance of animal food, in an excess of seasonings and condiments, in the use of tinned meat, or in too many iced drinks. It is, of course, true that, unless used with moderation, any of these things may be the cause of intestinal derangements, but there is no very conclusive evidence of a definite connection with Sprue. Some of the arguments that have been adduced are as follows :—

MEAT.—It is frequently stated that the relative immunity of the native races is due to the smaller quantity of nitrogenous food which they consume, and that their habits of life in this respect conform to the natural indications of a tropical climate. No doubt this is so ; but, so far as Sprue is concerned, the expansion of the disease has coincided with a great reduction in the quantity of meat consumed by Europeans. Further, meat-eaters in the Tropics are not speciably liable to intestinal disease ; on the contrary, a certain quantity of animal food is essential to health, and experience leads to the belief that vegetarianism conduces to the general condition in which Sprue originates.

The observance of the following dietetic maxims in the Tropics may assist in the prevention of Sprue and other intestinal disorders :—

(1) When fresh meat (including poultry, game, &c.) can be procured in good condition it should form the chief constitutent of two meals daily, if sufficient exercise is taken.

(2) Fresh meat is preferable to preserved, tinned, or salted flesh of any kind.

(3) On account of the liability of meat to contamination, and the rapid development of micro-organisms, cold meat should be avoided, and all meat should as far as possible be eaten hot and freshly cooked.

(4) When it can be obtained, fresh fish is essentially suited to the dietetic requirements of the Tropics, and should always form a substantial item in the daily fare.

(5) Vegetables are generally somewhat unsatisfactory, but when they are available they should be utilised. Tinned vegetables are less liable to objection than tinned meat.

(6) Fruit should be eaten daily, but only with the morning or midday meals.

(7) Raw vegetables, such as lettuce and other salads, are dangerous. Shell-fish and crustaceans (with the exception of well-cooked prawns) are unwholesome, while pork and ducks as a rule are wisely avoided by tropical residents.

CONDIMENTS AND SPICES.—The suggestion that an excess of hot curries, pickles and seasonings actively predisposes to Sprue is unsubstantiated. Malays and other natives who eat an extraordinary quantity of such relishes seldom or never suffer from Sprue, whilst most Europeans who come under treatment state that they have always avoided highly seasoned dishes. As a matter of fact, curry with plenty of rice is excellently adapted for use as a tropical food. It should, however, never appear as one of the courses of an otherwise substantial meal, but, served alone, there is no more wholesome and digestible luncheon than two or three simple varieties of meat and vegetable curry with an abundance of rice.

TINNED MEAT has fallen under suspicion partly on the ground that the symptoms of Sprue resemble, to some extent, those of metallic poisoning, but chiefly because the greater incidence of the

disorder on Europeans appears to indicate that it is caused by a food which is habitually consumed by them, but which is not generally eaten by natives. The consumption of tinned meat by Europeans in the Tropics, although much smaller than formerly, is still considerable; and it is greater in country districts where fresh or frozen flesh is often unprocurable. Although the latter circumstance has been held to explain the prevalence of Sprue on plantations, there are many reasons to discredit the belief that the disorder is due either to metallic or to any form of ptomaine or meat-poisoning. No similar symptoms have been recorded in troops on active service, who have lived almost exclusively on tinned meat for months; and the theory does not explain the exemption from Sprue of certain parts of the Tropics, where preserved and tinned meats are used in large quantities. Recent allegations as to the inferior quality of the meat which was exported by American houses, and statements as to the grossly unsatisfactory conditions under which it was packed, have, naturally, checked the consumption of tinned meats in the Eastern Tropics, but there is no reason why they should not be as wholesome as they are convenient. If good quality and sanitary supervision were assured, and if it were required that the date of packing should be stamped on each tin, the process of sterilisation and preservation obtained by "canning" meat would be efficient, and on the whole satisfactory.

ICE and COLD DRINKS are also asserted to predispose to Sprue. There can be no question that the excessive quantity of ice used by Europeans in the Tropics is deleterious, and that it tends to gastric and intestinal derangements. Cold drinks, however, cannot be regarded as having any definite relation to Sprue. In America, Australia, and other places which are practically exempt from Sprue, iced water and iced drinks are consumed in even greater

quantities than in the Eastern Tropics; and in the country districts where Sprue is prevalent ice is often unprocurable. Formerly, ice and cold drinks were carefully avoided by Malays and Chinese, but of recent years the native consumption of ice has become very considerable. As the most dangerous microbes of sewage contamination are unaffected by cold, and as ice cannot be sterilised, it is often a highly dangerous commodity, and regulations to prevent the sale of ice of doubtful purity are urgently required.

ALCOHOL.—How far the habitual or excessive use of stimulants predisposes to Sprue and other intestinal disorders in the Tropics is a question of wide importance, and one that can be answered only by unprejudiced clinical experience and observation. So far as Sprue is concerned, one thing at least is certain, total abstinence does not secure exemption from attack. On the contrary, Sprue occurs more frequently, in proportion to numbers, in those who abstain from alcohol altogether than in moderate drinkers. The evidence of antagonism between alcohol and Sprue, when once established, is conclusive; but it is very far from being the case that the moderate use of stimulants in health conduces to the development of the disorder. In the Tropics, however, as in colder climates, the effect of alcohol is modified by age. Epithelium is more easily damaged in youth than in advanced life; and for young men all stimulants are unnecessary. Up to the age of thirty, if taken in moderation, they are harmful, and their free use certainly contributes to derangements and organic disease of the digestive apparatus; but, as maturity approaches, a moderate quantity of stimulant is seldom harmful, and it may even be beneficial. If Sprue is seen in a young man, it will generally be found that he has been a free liver, and a direct connection can almost invariably be traced between excess and the commencement of the disorder. On the other hand, if the histories of cases in which the disorder

does not develop until late in life are followed, moderate drinkers are found to be, proportionately, in a minority. The preponderance of incidence is then on those who are abstemious both in eating and drinking, and who are anæmic and poorly nourished.

The physician is sometimes asked whether predisposition to Sprue is most likely to result from the habitual use of spirits, wine, or beer. Dilution is the most important factor in the devitalisation of epithelial cells by alcohol, and the comparative effects of different stimulants depend, almost exclusively, on their admixture with water. Some are, however, more readily assimilated than others, but, provided the digestion is sound, all varieties of stimulants have a similar influence. Whisky and soda water in very free dilution is now the usual drink in the Tropics, and alcohol cannot, perhaps, be taken in a more innocuous form: concentrated or "short" drinks such as sherry, or gin and bitters, before meals, and liqueurs afterwards, are particularly deleterious; and strong rich wines like port and burgundy are unsuitable for tropical consumption. On the other hand, light clarets, Sauternes, Moselle and Rhine wines—all of them preferably diluted with water or soda water—are well adapted for use in hot climates, and, if taken in moderation, certainly do not tend to the development of Sprue. Stout and ale should as a rule be avoided, although the lighter beers may often be taken without harm.

EXERCISE.—In the Tropics, much importance is rightly attached to muscular exertion as a means of maintaining the general health. There are few Europeans who do not take a sufficient amount of some variety of exercise, and in the great majority of instances the effects on the circulation, on the muscular system, and on the digestion are highly beneficial. Men—and women—who regularly seek relaxation in a moderate amount of tennis, riding, golf, or walking are invariably "sounder" and "fitter" than those who are

indolent and inactive. They are constitutionally more efficient, physically and mentally more active, less irregular in function, and more resistant to climatic disease.

Yet, the term "moderation" must be strictly interpreted. Exercise may easily be overdone, and in the pursuit of their favourite recreation, many European residents of the Tropics habitually exceed their capacity. If a visit is paid to a tennis or racket club at the close of the afternoon, no special knowledge is required to see that many of those who have been most active participants in the game have outdone their strength, and have, in their own words, "played themselves to a standstill." Congested faces, shortness of breath, and restlessness are obvious indications of an over-taxed circulation; and although the strain is relieved for the time by copious draughts of whisky and soda, its repetition invariably induces a condition in which decay of the arterial and heart muscle fibres frequently originates.

Most of those who indulge in this reckless pursuit of the cult of exercise are persuaded that in some way they are doing themselves good, and that the more closely exertion approaches exhaustion, the more benefit are they likely to derive. The later life of these enthusiasts is, however, characterised by a tendency to three different types of disorder. The results of fatigue thus systematically induced are manifested in the circulation as myocardial degeneration, in the muscular system as myalgia and atrophy, and in the digestion as Sprue.

There can be no doubt as to the large proportion of Sprue patients recruited from the ranks of those by whom fatigue is habitually confused with exercise. The connection is one of predisposition and not of direct causation, but it is a material factor in the incidence of the disease, and the possible consequences of repeated over-exertion in the Tropics should always be borne in

mind. Again, those who take no exercise at all are exceptionally prone to Sprue; and by far the smallest percentage of cases is furnished by the class who take exercise in strict moderation.

DRESS.—As chill is so frequently the starting-point of intestinal affections in the Tropics, the question of clothes is one of some importance. Obviously, dress ought to be accurately suited to the climate in which it is worn. If too heavy, it is exhausting and uncomfortable; if too light, it may be dangerous; but, as climatic conditions are less irregular and uncertain than at home, the adaptation of dress in the Tropics should seldom occasion much difficulty. During the day, in the heat of the low country, clothes of white drill or jean are preferable to any others; while at night, thin Ceylon flannel will be found the most suitable wear, In the upland districts, woollen and tweed suits are necessary for day use. The best underwear for hot climates is a mixture of silk and wool (tropical weight). When silk or cotton sleeping suits are worn in the hot weather, a "cholera" belt or abdominal flannel bandage should always be worn.

HOUSE ACCOMMODATION.—In former times, Europeans lived for the most part in thatch-covered bungalows, in which the rooms were carefully protected from the direct rays of the sun by wide verandahs. In construction, space was considered of little account, and the free circulation of air was secured by the partitions being left incomplete at the ceiling. Recently, the usual type of house has changed; the increase in the price of land, and municipal regulations for the prevention of fire, have necessitated economy in building space, and the substitution of roof materials which are less efficient non-conductors of heat. Rooms are smaller, and often without verandahs; and the general design is based on neatness of appearance and conformity to a European model rather than on abundance of ventilation and air space.

Formerly, too, it was possible to select sites where there was natural drainage, and which were especially suitable for house construction. Houses, however, have now to be built where there is room; drainage and other sanitary conditions are defective; and, unless high and sometimes excessive rents can be paid, it is often impossible to secure a healthy house. The greater part of the European population of the Tropics—those to whom economy is a first consideration—now live in houses which are entirely unsuited for habitation, and it is amongst this class that Sprue is exceptionally prevalent. Europeans who are able to live in good houses are by no means exempt, but they are, unquestionably, less liable to infection.

It is difficult to see what remedy can be found for this state of things. The rents which can be paid furnish but a poor return on the capital that is invested in house property; while the price of land, and the cost of materials and of construction, continue to increase year by year. The very prosperity of the Eastern Tropics precludes the possibility of much improvement in the house accommodation which can be placed at the disposal of the poorer Europeans.

CHAPTER XXV.

Removal from Endemic Area.

So soon as it is apparent that a European who is resident in the Tropics has become affected with progressive Sprue, it is the duty of the physician to advise him to remove from the region of endemicity. He should return home, or seek a more suitable climate, as soon as possible; but in advising a step which requires considerable powers of endurance, and which necessarily entails a large expenditure, circumstances have to be taken fully into account. In the first place the patient must be fit to travel. Doubtless, many lives are lost which might have been saved by timely repatriation, and removal, to be of any avail, must not be postponed until the malady has reached its ultimate stages. Nothing is more pathetic than to see invalids exhibiting the last phases of Sprue placed on board ship. In such cases the strength is seldom sufficient to withstand the fatigue which is inseparable from a journey, and the inevitable termination is only accelerated by the belated attempt to reach home. Not infrequently, death occurs within three or four days, and it is obvious that these patients should never have been allowed to leave their homes. In other instances the voyage appears to be borne fairly well, and occasionally to effect a little improvement, but the circulation is so enfeebled that patients succumb to the cold of the

temperate zone, which even in summer is acutely felt by tropical invalids, and to which they are particularly susceptible. One of the gravest responsibilities cast upon the tropical physician is to decide whether, in cases of climatic disease, the vitality is adequate to meet the effort imposed by removal. The general condition, the strength of the circulation, the extent to which toxæmia has progressed, the season of the year, the circumstances of the patients, have all to be carefully considered; and when it is evident that the voyage cannot be accomplished without risk, or that death is likely to occur on board ship, they should never be allowed to embark.

Season is also of paramount importance, and although removal may be urgently indicated, delay is generally advisable until it is improbable that severe cold will be encountered on the voyage. Moreover, the excessive heat of the Red Sea in the months of July, August, and September, or the monsoon season in the Indian Ocean during June and July, may be almost as prejudicial to a patient as the cold of an English winter. The best time for return to Europe from the Eastern Tropics is in the late spring—in April and May; and if the journey cannot be undertaken at that season, the question arises whether the patient may not, with advantage, be sent to one of the Australasian States.

In many cases, again, the circumstances of a patient do not admit of his removal to a country where he can obtain the requisite food and nursing, and unless these can be assured he should not leave the East. The conditions of life in Europe are insufficiently understood by many who have been brought up in the Tropics, and invalids of that class frequently undertake the voyage only to find that the necessary treatment is entirely beyond their reach. It is not generally appreciated, even by those who are familiar with the facilities at the disposal of the sick, how scanty

and inadequate is the provision that is available at home for tropical invalids. In England, the very poor have unequalled opportunities of attention and care during illness; so also have the rich, who can afford to pay the high charges which are incurred for treatment in nursing-homes; but for the middle classes — who represent to a large extent the community from which tropical patients are drawn—little or no assistance can be obtained at a reasonable cost. It cannot be too clearly understood that removal to a temperate climate without proper facilities for dietetic and other treatment is worse than useless, and that unless satisfactory arrangements can be made at home the consequences of sending a Sprue patient to England will, in all probability, be disastrous. Sprue can be effectively and successfully treated in the Tropics, and the care of such cases should always be undertaken there. The danger of return to England without the knowledge of the necessity of obtaining adequate dietetic treatment, and without the means of providing comfortable nursing and accommodation, is far greater than the risk incurred by remaining within the endemic area.

On the other hand, when proper arrangements can be made, the timely return of Sprue patients to a temperate climate is almost invariably followed by marked improvement in the general condition. Not only can the diet essential to recovery be more easily obtained, but the benefit which accrues from the feeling of being at home, and from the change of surroundings, is generally prompt and permanent. In every serious case, the issue and the prospect of effecting a cure depend on the conditions in which the patient is placed, and these are very material considerations.

When return to Europe has been settled, the patient should go at the earliest opportunity, and should hasten rather than retard his departure in order to arrive at a suitable season. Delay is

dangerous, and it is unwise to temporize, or to try half-measures. Removal to a Hill station is, probably, the worst of the various courses which may suggest themselves; for the high sanatoria of the Tropics, invaluable as they are in other conditions, are seldom or never suitable for Sprue patients. On this point there is complete accord between French, Dutch, and English authorities, and that there is abundant clinical confirmation of the truth of their statements is well known to all who have experience of practice in hot climates. MM. Le Roy de Méricourt and Carré long ago said[1]: "Patients should never be removed to higher altitudes of the climacteric zone where the malady has been contracted." MM. Bertrand and Fontan are no less decided, and say tersely, "Let there be no parley with the disease; *Rapatriement aussitôt qu'il est devenu nécessaire!*" Van der Burg instances more than one case in which a benign form of the disorder was transformed into a condition of marked malignancy by a temporary sojourn at a Hill station in Java. In his work "Indische Spruw,"[2] he says: "Removal to the uplands always does more harm than good."

It is unnecessary to say that careful preparation must be made for the voyage. Indications as to diet suitable for use on board ship have already been submitted, and special precautions to avoid chills are imperative. Not the least of the discomforts and dangers to which Sprue invalids are liable on transition to a temperate climate is the inadequacy of the circulation in the extremities, and their persistent tendency to cold in the hands and feet. A plentiful supply of woollen clothing, flannels, warm gloves

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[1] Cochin-Chine: *Dict. Encyclop. des Sciences Médicales.*

[2] Batavia: Ernst and Co., 1880.

and socks is, therefore, always indispensable. Chills which may induce grave relapses are frequently contracted by insufficient attention to these details, and although the advantages of abundant fresh air are unquestionable, exposure to cold should be permanently avoided, and for many months after his return to Europe the patient should invariably be abundantly clad.

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